January

25 Cent

Science and Invention

IN PICTURES

THE SNOW BURNER

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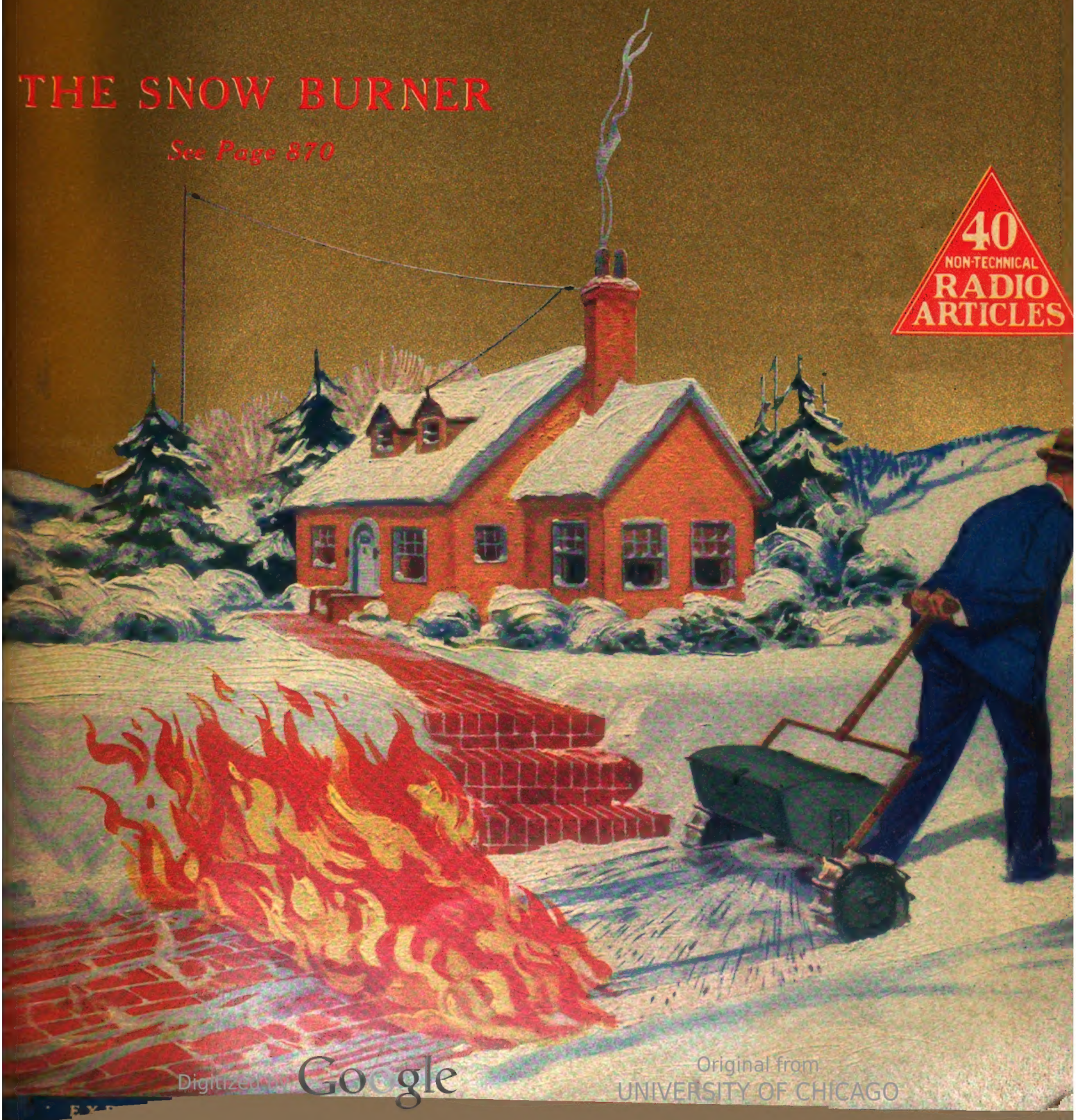
40 NON-TECHNICAL RADIO ARTICLES



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Vol. XII.
Whole No. 141

Science and Invention

FORMERLY
ELECTRICAL EXPERIMENTER

January, 1925
No. 9

In Our Next Issue

Will the future doctor treat us from a distance?

A futuristic article dealing with the great possibilities of radio television and telautomatics is applied to the science of medicine and other subjects which make our daily life more enjoyable and safer. How doctors may be able to feel the pulse, take the blood pressure, percuss various portions of the body, and possibly operate on patients by radio.

A realistic shipwreck on the stage!

How "prop" ships are made to give a most realistic effect of burning on an ordinary theatre stage. You can hear the flames roar, see them creep inch by inch along the woodwork and even see a tremendous mast fall with a thunderous crash to the deck of the ship. All this and more has been reproduced on the stage.

Did you know that there was a relationship between hair and the detection of crime?

Hereafter criminals will do well to keep their heads shaven and do this work themselves, carefully destroying every particle of hair. If they do not do so, the long arm of the law may overtake them, due to clues furnished by small hairs.

Do you want a motor speedster?

An automotive engineer will tell you how to build an auto speedster that is practical and safe. The article will be accompanied by the detailed drawings and diagrams that have made the "Constructor" articles of this magazine justly famous.

The above are just a few of the treats in store for our readers in the next issue. Hundreds of photographs and illustrations will also be published, accompanied by short, to-the-point descriptions.

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Publishers of SCIENCE & INVENTION, RADIO NEWS, THE EXPERIMENTER and MOTOR CAMPER & TOURIST.

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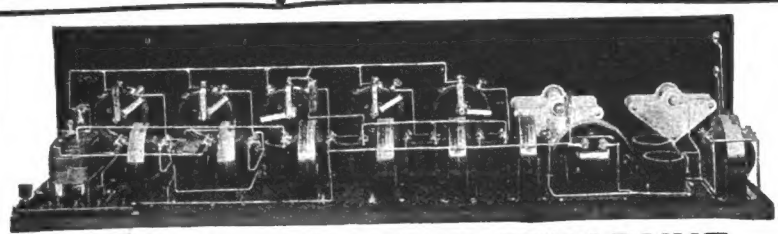
Every article exactly as represented. Every article is tested before shipping. Complete satisfaction guaranteed or money will be cheerfully refunded.



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2 Thordarson or Columbia A.F. Transformers
1 Connecticut Filament Switch
2 Bakelite 6-ohm Rheostats
2 Bakelite 30-ohm
1 Bakelite Potentiometer, 400 ohms
1 Carter Double Circuit Jack
1 Dubilier 1 mfd. Condenser
1 .006 Mica Condenser
1 .0005 Mica Condenser and 2 megohm Grid Leak
3 .0025 Mica Condensers
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1 Bakelite Terminal Strip for Binding Posts
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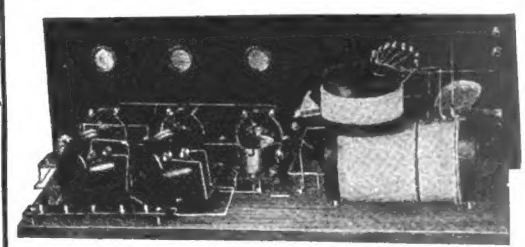

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1 Bakelite Rheostat, 6 ohm.
2 Bakelite Rheostat, 30 ohm.
3 Bakelite Sockets
1 high ratio Columbia or Thordarson Transformer
1 Single Circuit Jack
1 low ratio Columbia or Thordarson Transformer
2 Double Circuit Jacks
2 3 in. Bakelite Dials.
1 Grid Leak and Mica Cond.
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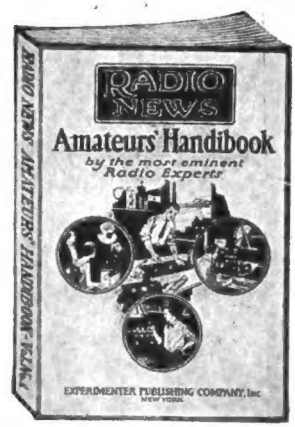

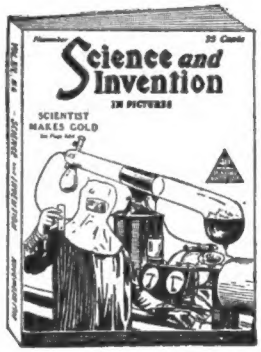

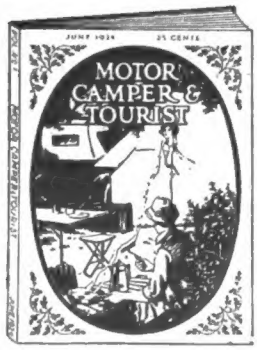

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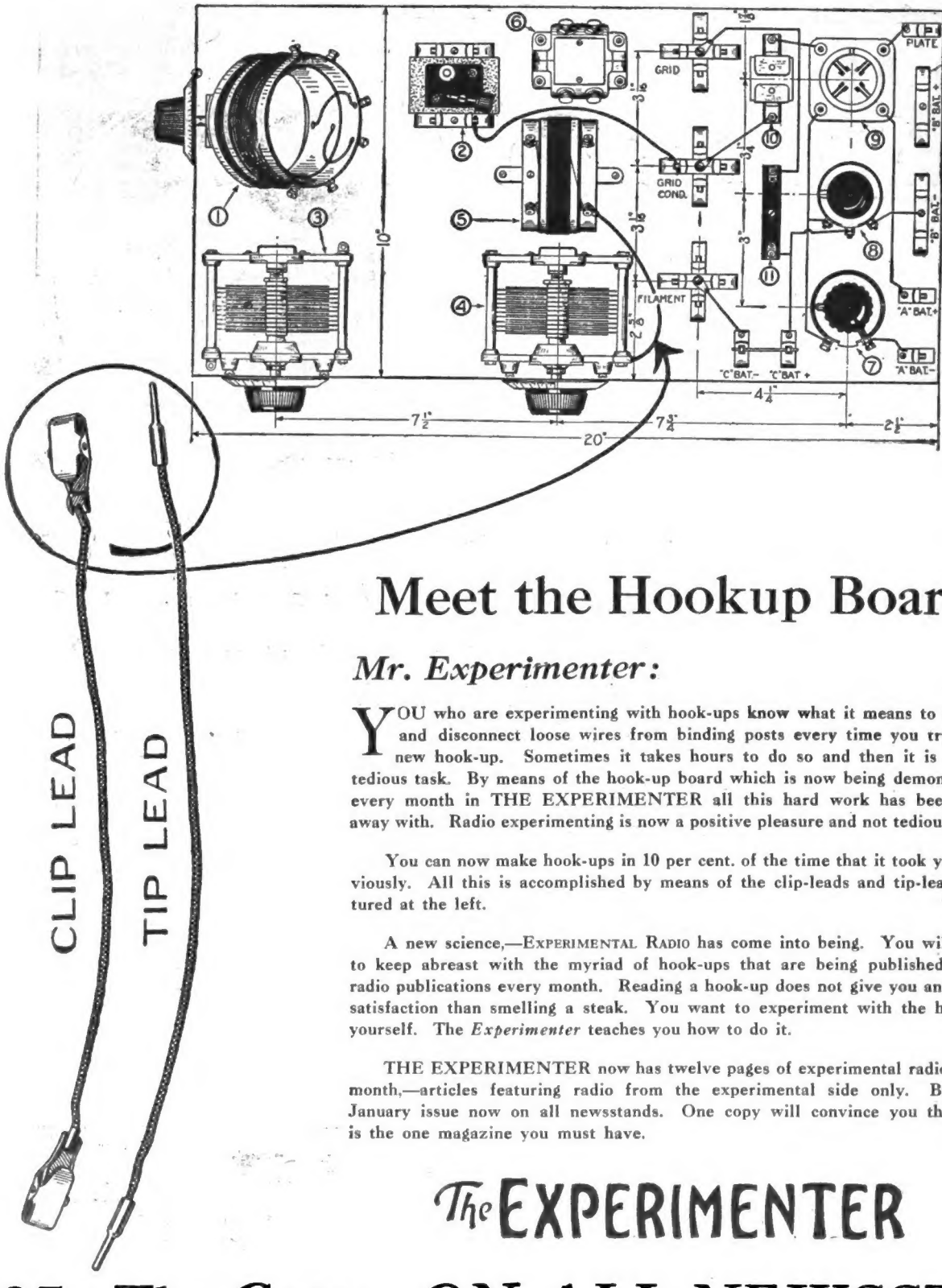

1000 Hookups

Meet the Hookup Board

Mr. Experimenter:

YOU who are experimenting with hook-ups know what it means to connect and disconnect loose wires from binding posts every time you try out a new hook-up. Sometimes it takes hours to do so and then it is a most tedious task. By means of the hook-up board which is now being demonstrated every month in THE EXPERIMENTER all this hard work has been done away with. Radio experimenting is now a positive pleasure and not tedious work.

You can now make hook-ups in 10 per cent. of the time that it took you previously. All this is accomplished by means of the clip-leads and tip-leads pictured at the left.

A new science,—EXPERIMENTAL RADIO has come into being. You will want to keep abreast with the myriad of hook-ups that are being published in all radio publications every month. Reading a hook-up does not give you any more satisfaction than smelling a steak. You want to experiment with the hook-up yourself. The *Experimenter* teaches you how to do it.

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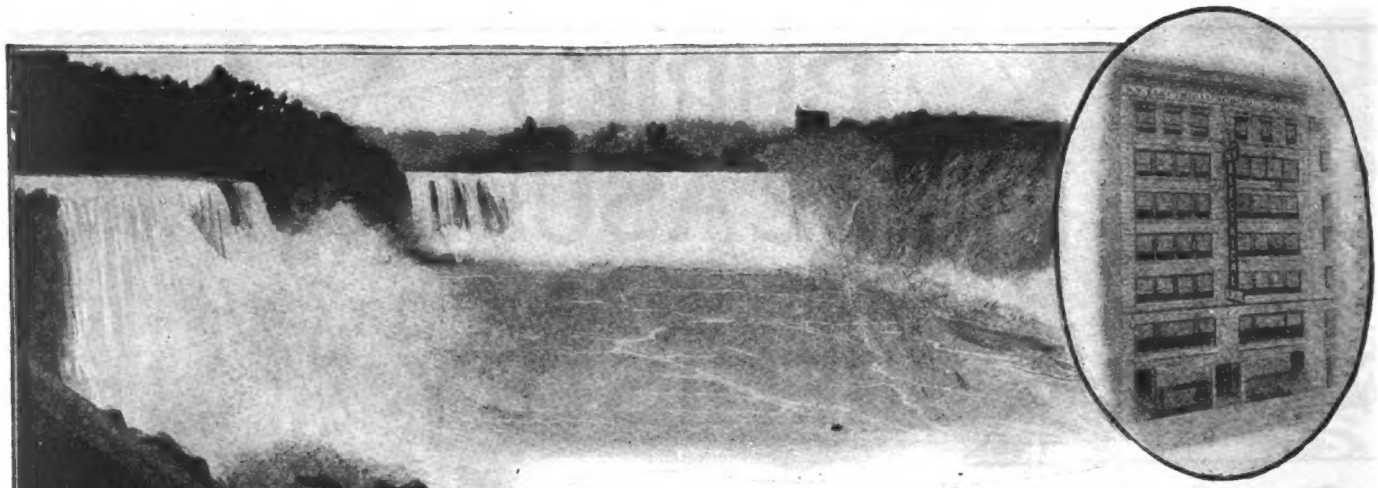

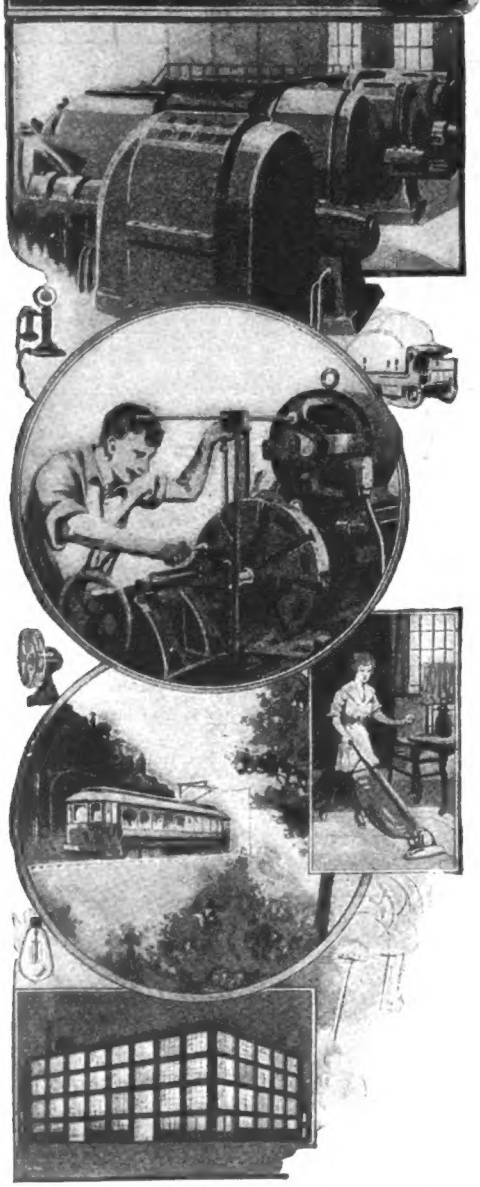

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"Those Who Refuse to Go Beyond Fact Rarely Get As Far As Fact" - - - HUXLEY

The Dark Age of Science

By HUGO GERNSBACK

TOO many people nowadays are prone to settle themselves back in their chairs and congratulate themselves about the wonderful age in which we are living. With railroads, airships, radio and other "marvelous" activities abounding around us, it is easy to lull oneself into the belief that surely the millenium has arrived and that the world will never look rosier than it does now.

I BELIEVE THAT:
the wheel was one of the greatest inventions of all times.

As a matter of fact, 300 years hence this present age of ours will probably be termed the "dark age of science." This is not merely a catch phrase used by the writer, but he means it in all sincerity, and what is more, he can easily prove it.

Nowadays it makes us laugh when we think of how people in England and other parts of the world some five hundred years ago on top of coal mines and froze to death. They simply did not know that coal would burn and that it could be made to heat houses and otherwise perform tremendous work. While we laugh, you should soberly consider that we are doing the self same thing ourselves today. All about us there is untold quanties of energy, much cheaper, much better, more sanitary than coal, but we simply have not learned how to use it because we do not know. Every piece of rock, every car full of sand has a potential dormant power locked up within it. We may call this power atomic or by any other name, but the fact remains that we do not use it because we do not know how.

I BELIEVE THAT:
sooner or later governments will subsidize all inventors of repute.

Take a great city like New York, which burns thousands of tons of coal whose products pollute the atmosphere every day, while right at its very feet two mighty rivers, the Hudson and the East Rivers flow by its shores, which rivers every day can actually furnish more power than all the coal burned in a year. Still, this mighty power goes to waste in this dark age of ours.

When you go to the butcher and order a 10-pound roast, you would become highly indignant if he handed you over 9¾ pounds of bones and less than ¼ pound of meat, but when you pay your electric light bill at the end of the month and you send the lighting company your check for $10.00 you do this very thing. The reason is that exactly 98% of the electric power goes up in useless heat, which you do not need and which you do not want but which you must pay for. You actually get 2% of light, and in order to get this 2% you have to pay 98% for something that is a total loss. Of course all this will make people laugh merrily 300 years hence, and they will not be able to understand how we could afford such frightful losses.

Then we go and invent the automobile, another monstrosity of the "dark age of science." In order to propel the same, we generate carbon-monoxide that pollutes the air in our streets, gives us headaches, and otherwise makes life unbearable for us. But this is far from being the worst. Here we go and create the automobile and then build so many of them that they become useless by their very numbers. Instead of transporting us quicker than the old horse-drawn vehcle, we actually find that the latter was much faster, in many instances. If you try, in any of our big city streets, to go about quickly, you will find that there is only one way of doing it and that is you must come right back to prehistoric times and *walk*. In cities like New York and Chicago, you can cover ground much quicker for reasonable distances on foot than by automobile.

I BELIEVE THAT:
the human race has a lot to learn from the ants and the bees.

Far from living in the millenium, we are living in an age of unspeakable waste. There is hardly anything that we can think of that is not wasted.

We know today the power of waterfalls, the inherent power of the tides, the inherent power of moving rivers, yet—99% of this goes entirely to waste. Wind power, another large source of energy, is hardly touched at all. This power alone is so vast that a small fraction of it, properly applied, would supply the world with sufficient energy to run all the machinery, all trains and all of our vehicles. Water power and wind power are well understood and can be exploited by us even today, but no real effort in this direction is to be discerned.

We do not wish even to speak of the power derived from the sun's heat, because we have as yet not found the key to unlock this tremendous energy, which is far, far greater than all the others combined.

At the present time we simply use sun power that has been stored up by nature millions of years ago. This is the case with coal, gasoline and practically every other fuel. All other forms of energy that are lying about us in every direction are not even touched. It is a comforting thought that our great-great-grandchildren will stand on their own legs, for they will know how to unlock a power universe, invisible to us.

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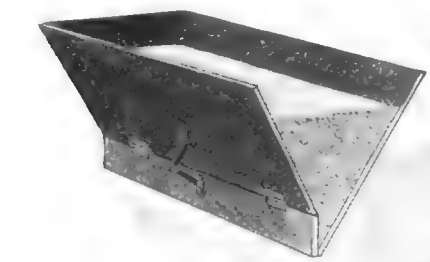
The Snow Burner

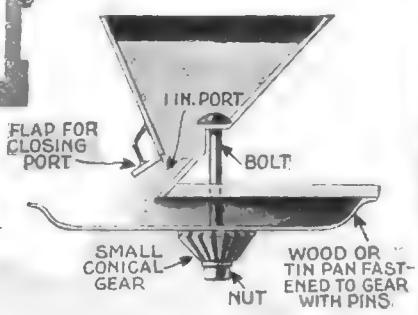
By JOSEPH H. KRAUS

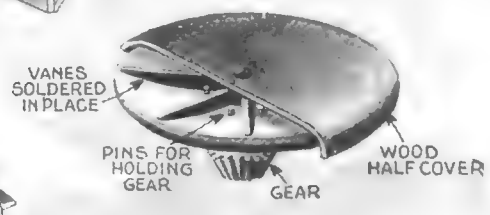
A New Scheme for Clearing Snow from Sidewalks

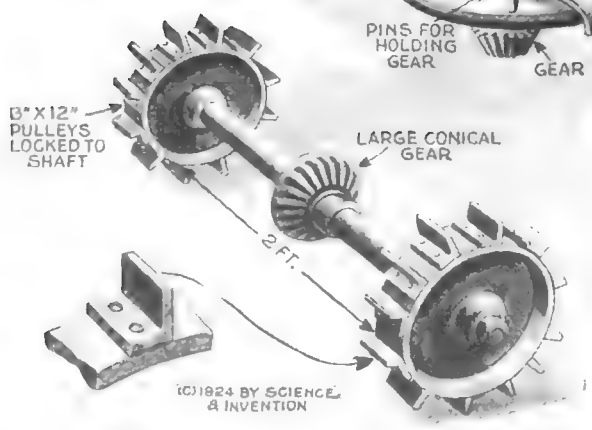
A simple experiment for seemingly burning snow is illustrated in the above drawing. A hole is first poked into the snow with the finger or with a stick. A piece of calcium carbide is then dropped into the hole and snow packed lightly on top of the calcium carbide. The moisture present in the snow causes the calcium carbide to go into chemical reaction with the water and evolve acetylene which burns on the surface of the snow when ignited. The heat formed will melt the snow, and the heat of reaction will further aid the melting of the snow.

Based on the principle of the experiment illustrated in the upper right hand corner of this page, the suggestion for the experiment having been made by Harry E. Hale, the snow burner illustrated above has been devised. Essentially this consists of a means of sprinkling calcium carbide upon snow, and as the gas is evolved, it is lit with a match. The sprinkler is then drawn over the walks, and the flames follow in its wake, melting the snow which runs off in the form of water.









Great care must be exercised in sprinkling calcium carbide upon snow, so that when the gas is evolved and ignited, it will not set fire to shrubbery, trees or the house itself. Under no conditions should such a snow remover be used when a gale is blowing, and the individual drawing the mechanism over the road should always see to it that he heads into any slight breeze which may be blowing, so that his own clothes will not be ignited. A slow procedure is best because a large area of snow will not be heated at one time and the flame area is considerably confined. Above and to the left the principal parts of the mechanism are illustrated. It will be noted that a hopper containing calcium carbide slowly drops the carbide into a pan revolving at high speed. The pan is covered on the front half by a shield so that the carbide sprinkled out because of centrifugal force will only fall in back of the mechanism. For eliminating small patches of snow, the best system is to sprinkle the carbide out of a pan, as illustrated above.

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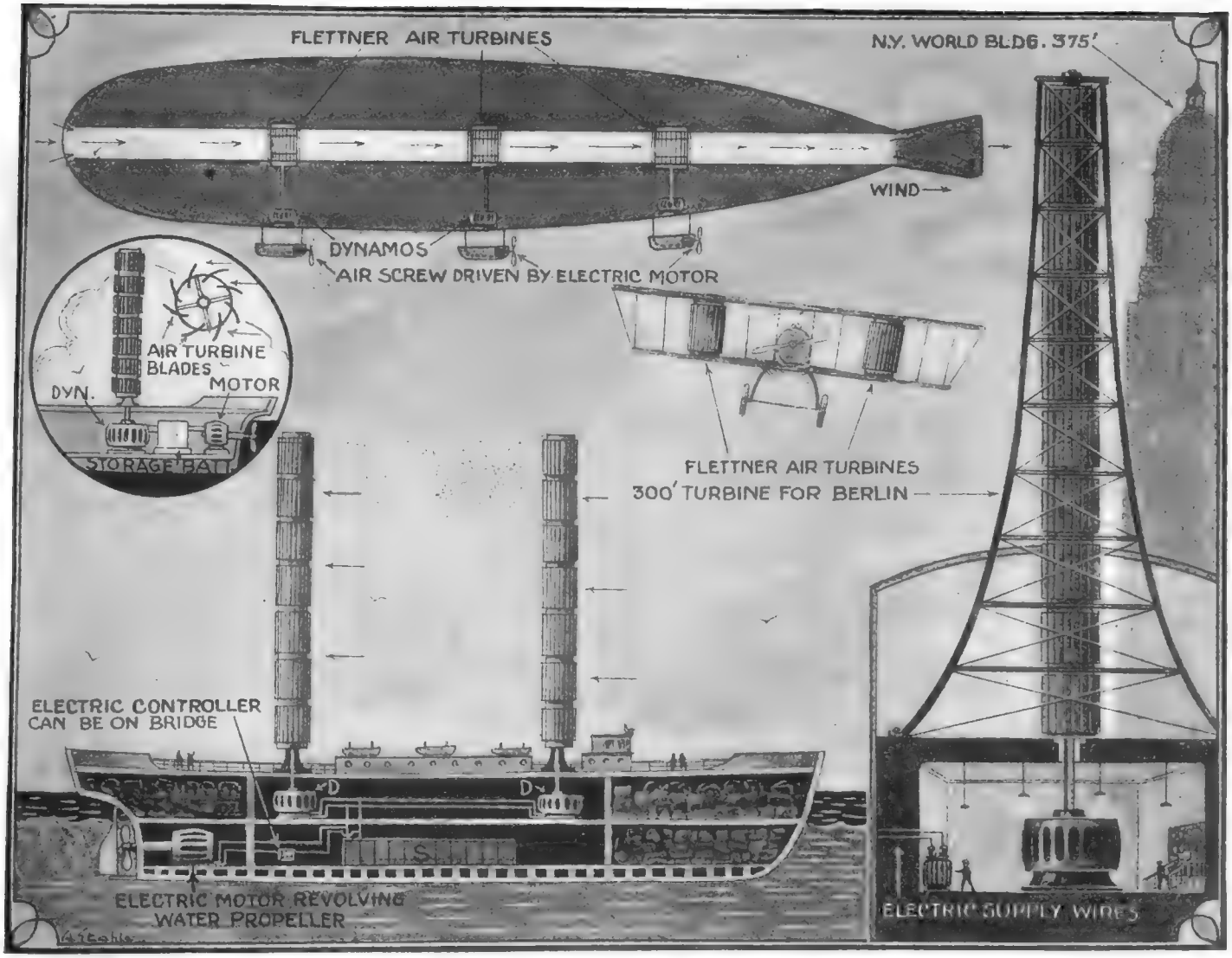
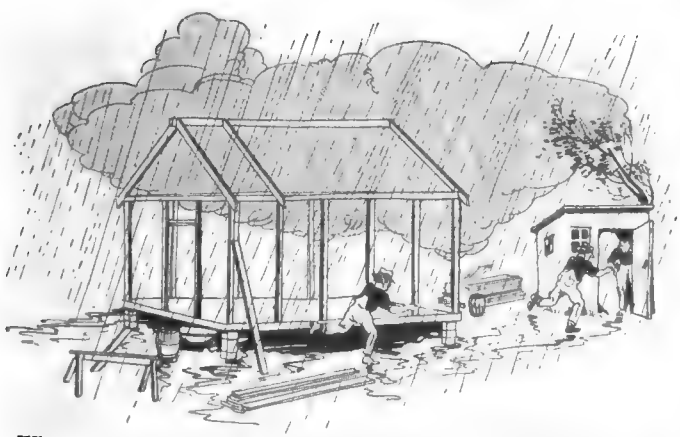
Sail-less, Engine-less Ships



Announcement has just been made by Anton Flettner that he will attempt to sail a sail-less ship across the Atlantic. This ship is to be fitted with two revolving cylinders each sixty-five feet high, which are in reality highly efficient air turbines, connected to dynamos D, which in turn supply current to storage batteries, S, thence to electric motor coupled to the propeller. The illustration also shows the simplest view of the Flettner turbine coupled with the dynamo, storage battery and motor. The method is applicable not only to vessels, but also to airships and airplanes, where the size of the Flettner turbines would be cut down considerably but a greater number would be used for turning dynamos which supply the motors coupled to the propellers with the necessary current. Strange as it may seem, it is absolutely possible to produce a ship of this nature which will sail faster than the wind. There is, however, no multiplication of power, but the wind power is utilized more efficiently and more flexibly in this wind turbine scheme. It is proposed to build a power plant in Berlin with tower 300 ft., high, comparable to the World Building in N.Y. City.

Building Houses While It Rains



Why not erect a large tent big enough to house a building until completed so that work need not be interrupted during a rainy spell, suggests the author. Such a tent might cost $500, but considering that labor cost $9 a day, and it requires six men three months to build a $10,000 bungalow, if but ten days were lost in the erection of the building, the cost of the tent would be saved on the first building and work expedited.
—K. G. Pratt, Reporter No. 7122.

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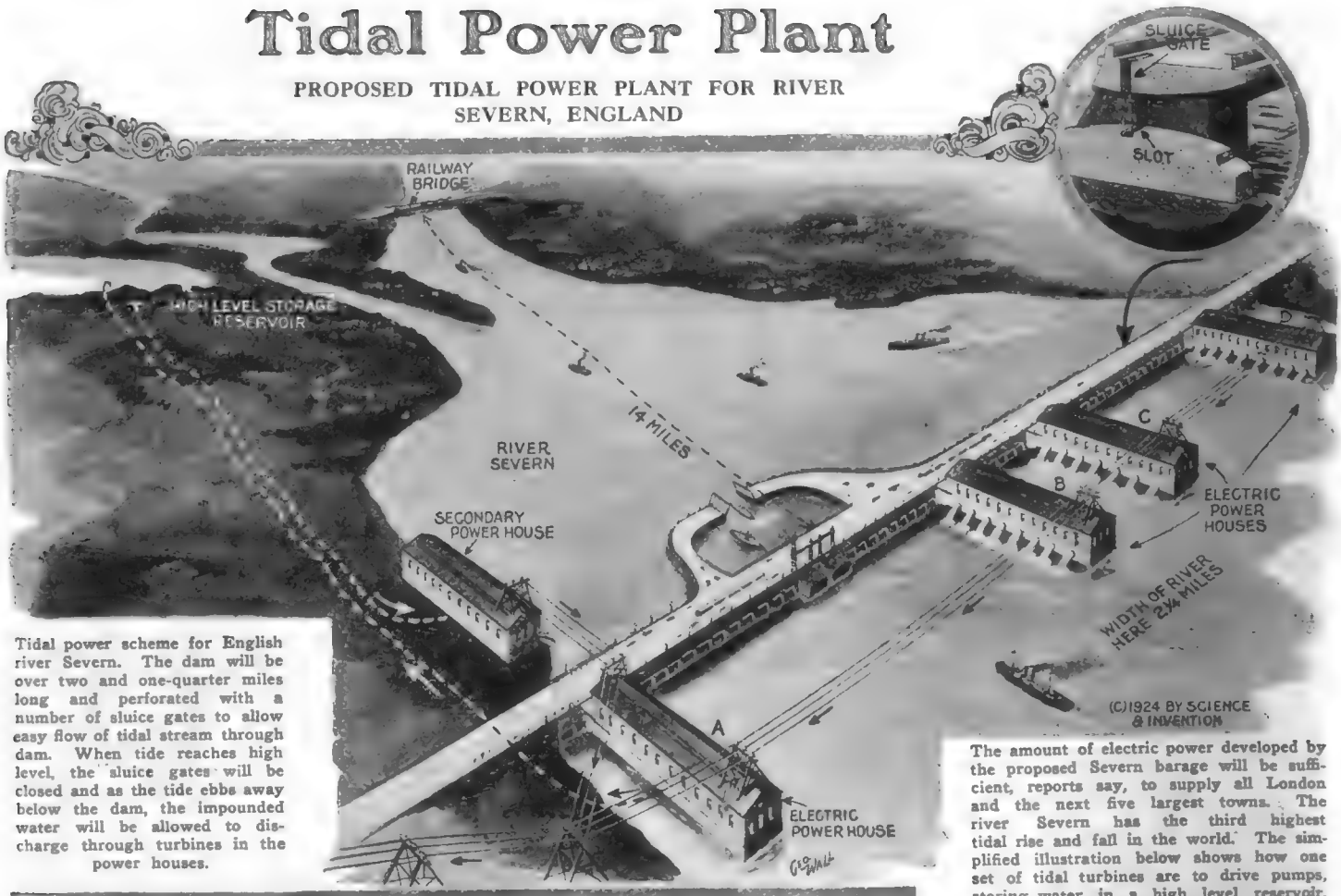
Tidal Power Plant

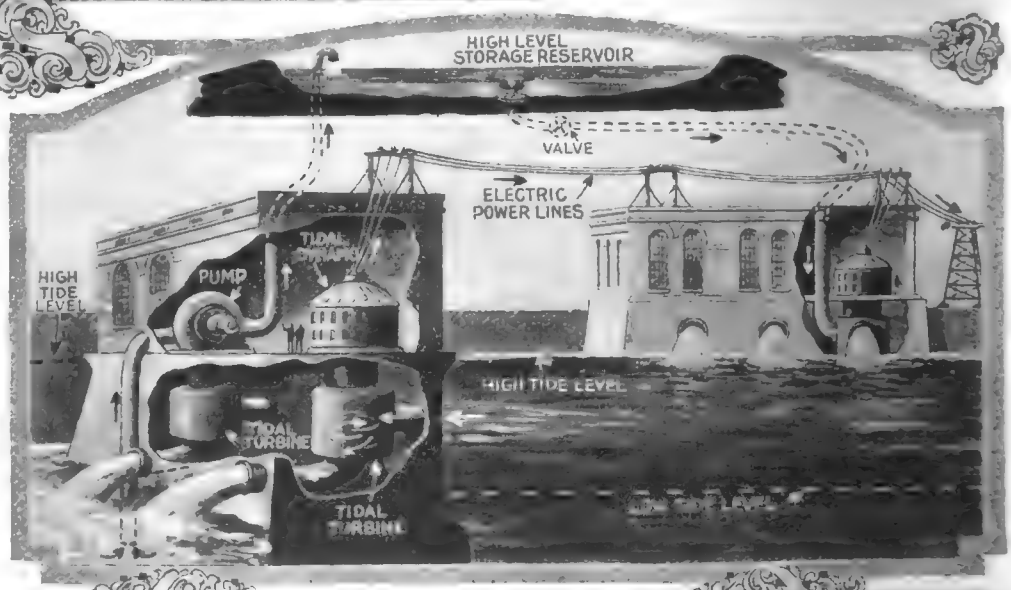
PROPOSED TIDAL POWER PLANT FOR RIVER SEVERN, ENGLAND



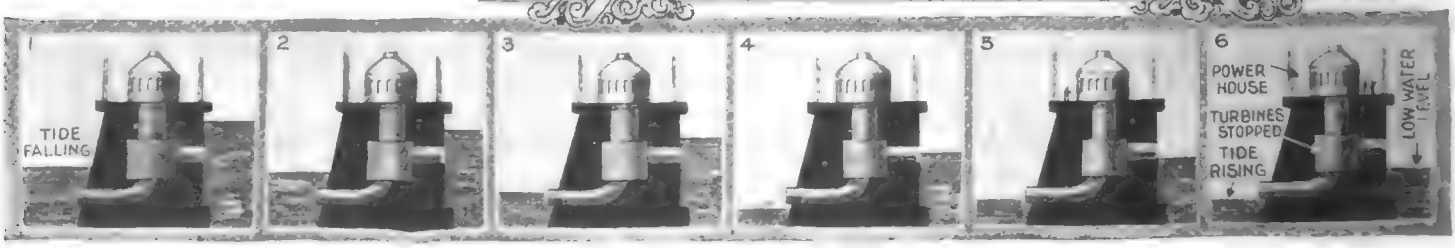
Tidal power scheme for English river Severn. The dam will be over two and one-quarter miles long and perforated with a number of sluice gates to allow easy flow of tidal stream through dam. When tide reaches high level, the sluice gates will be closed and as the tide ebbs away below the dam, the impounded water will be allowed to discharge through turbines in the power houses.

The amount of electric power developed by the proposed Severn barage will be sufficient, reports say, to supply all London and the next five largest towns. The river Severn has the third highest tidal rise and fall in the world. The simplified illustration below shows how one set of tidal turbines are to drive pumps, storing water in a high level reservoir, water from this reservoir being used to operate dynamo turbines when there is no tidal power available from the main power houses situated along the dam. That is, when the tide is out and all of the impounded water above the dam has been passed through the turbines, the auxiliary high level storage reservoir will be utilized, through the intermediary of the secondary power house, to keep the supply of electric current continuous.

The three small drawings numbered one to three above show how ships will be locked through the Severn power dam. Fig. 1 shows a ship entering the opening through dam into lock, in which the water is at the same level as that on the down stream side of the dam. Fig. 2 shows water level in lock raised so that ship is at same level as impounded water above the dam. Fig. 3 shows ship passing out of lock gates into impounded or upstream waters.



The six numbered progressive views below shows in a clear manner how tidal turbines operate. On top of each tidal turbine there is a dynamo which spins with the turbine blades and develops electric power. Fig. 1 shows one of the turbines starting to work with tide falling below dam. Fig. 2 shows turbine working at full power, Figs. 3 and 4 showing the same operation, while Fig. 5 shows turbine preparing to stop. Fig. 6 shows turbine stopped while tide rises.



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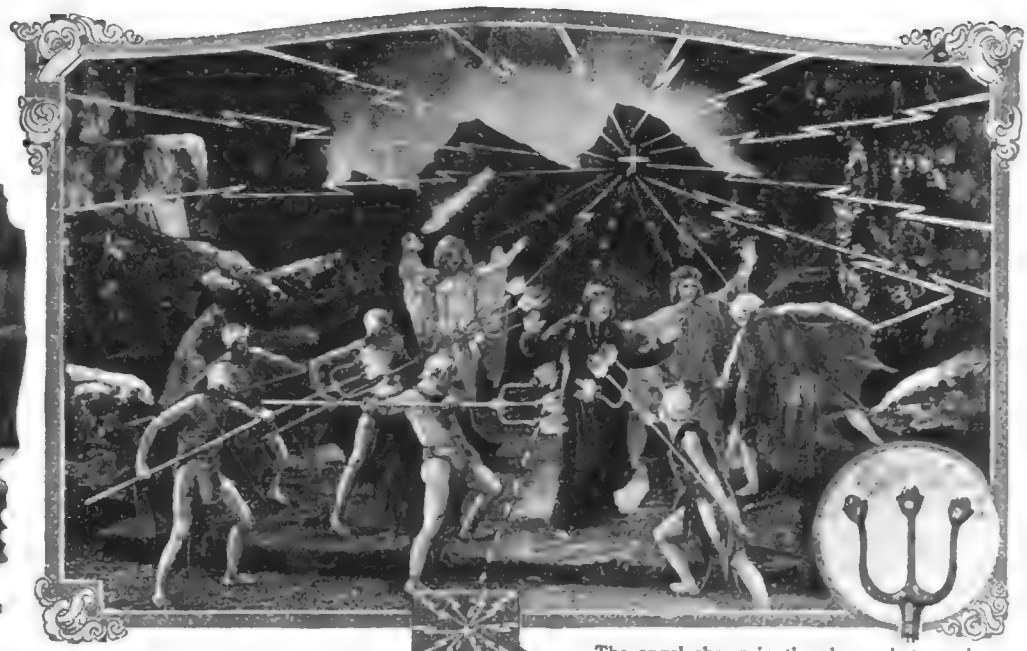
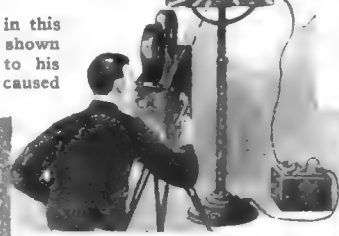
Dante's Hell Shown in Movies

One of the most unique characterizations in this William Fox super-picture is the imp shown above. An oily appearance was given to his skin by coating it with petroleum which caused it to shine.

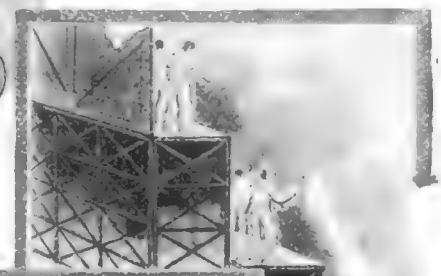


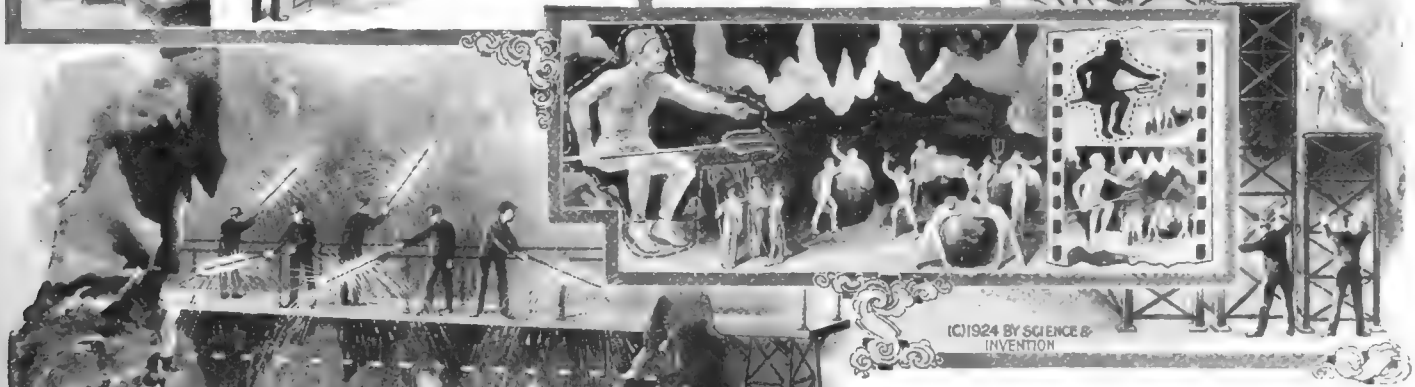
The angel shown in the above photograph appeared out of the center of lightning flashes, which were produced by setting a plate of glass immediately in front of the camera, painting the lightning flashes on it with quick-firing composition and igniting with spark.

Here is detailed a neat double exposure trick used.



In the judgment room in Hades, the judge appears about six times larger than the men brought before him. The method by which this startling effect was obtained is described below.





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Victims were tortured in a shower of "fire" by allowing them to roam about under huge "sparklers," such as used in Fourth of July celebrations.

The double exposure trick was done by photographing the figure of the judge in front of a dead black background, very near the camera. The film was then rewound with the portion covered by the judge blocked out with a template immediately in front of the film in the camera. The film was then run through again, exposing the remaining figures and the background at a much greater distance, the two perspectives giving the difference in size. Immediately above, to the left, is shown how the various tiers of the stairway of torture were caused to tremble. The papier maché rocks which composed the background were erected on wooden frames, which stage hands shook. The fire shower was accomplished by having stage hands shake huge sparklers down upon the players. The dotted line shows the range of the camera, which of course left out the men manipulating the sparklers

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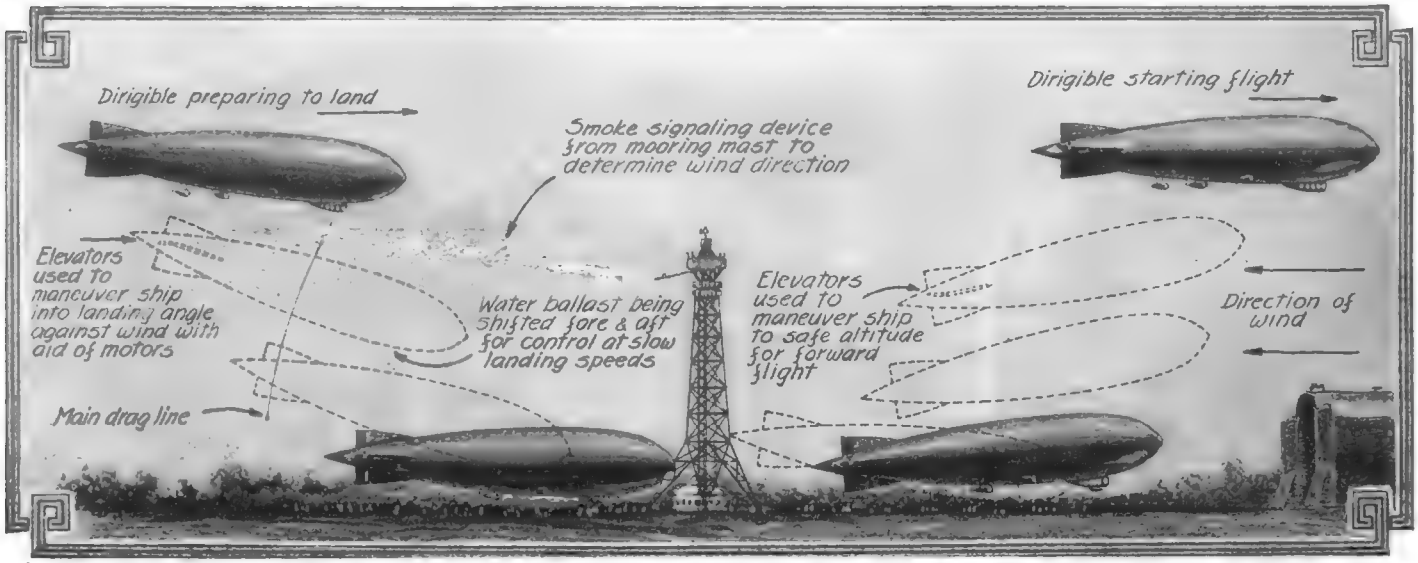
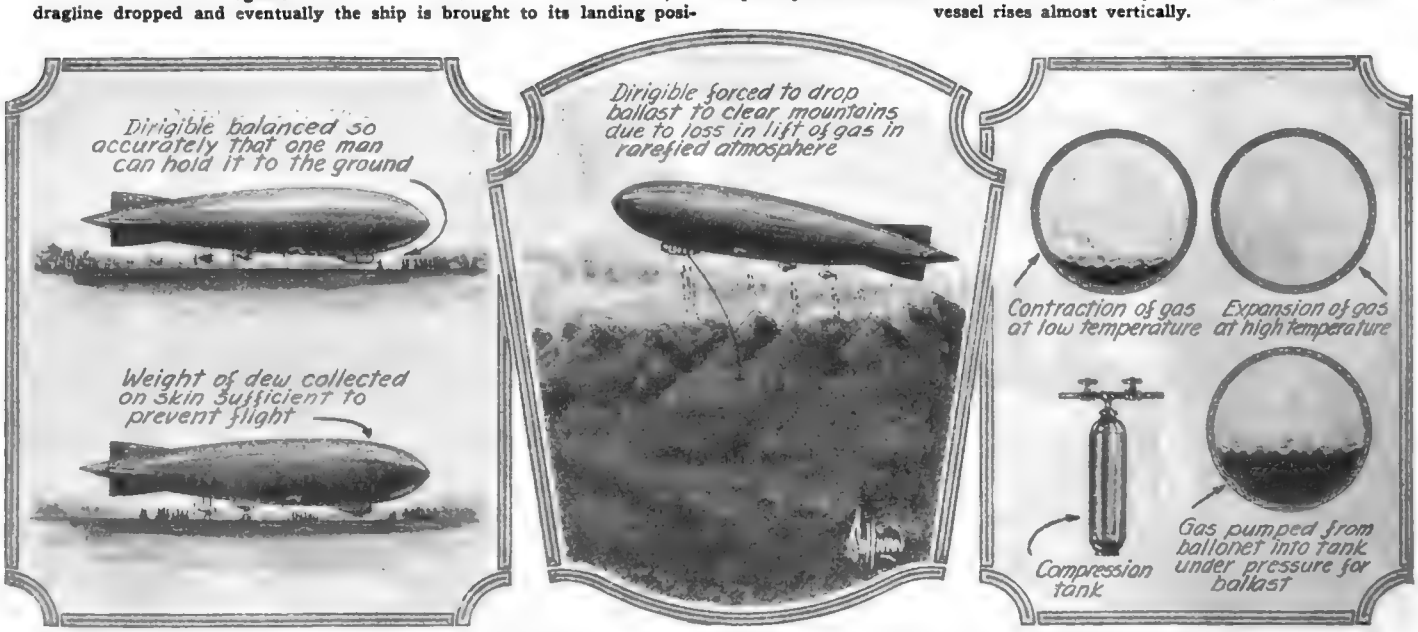
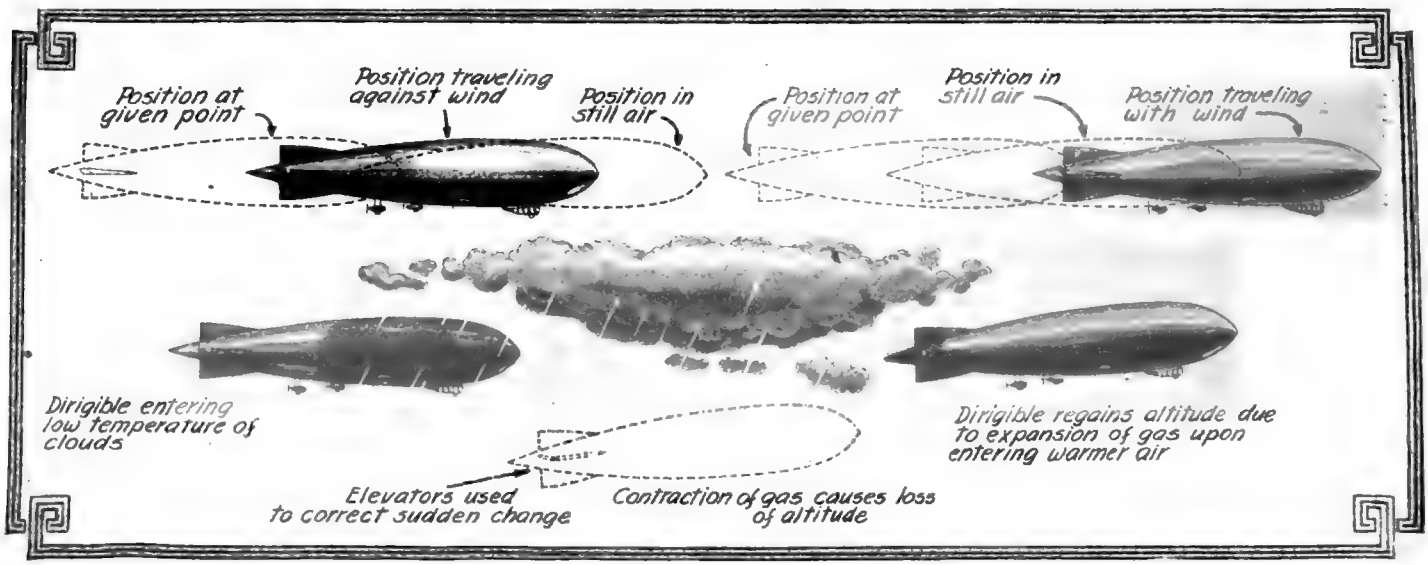
Little-Known Dirigible Facts


Dirigible preparing to land
Smoke signaling device from mooring mast to determine wind direction
Dirigible starting flight
Elevators used to maneuver ship into landing angle against wind with aid of motors
Water ballast being shifted fore & aft for control at slow landing speeds
Elevators used to maneuver ship to safe altitude for forward flight
Direction of wind
Main drag line

In landing a dirigible the ship does not ordinarily valve gas. The vessel is first manoeuvered against the wind with the aid of her motors, a dragline dropped and eventually the ship is brought to its landing position. In starting a flight, the propellers are permitted to turn over at a speed just sufficient to overcome the velocity of the wind, so that the vessel rises almost vertically.


Dirigible balanced so accurately that one man can hold it to the ground
Dirigible forced to drop ballast to clear mountains due to loss in lift of gas in rarefied atmosphere
Contraction of gas at low temperature
Expansion of gas at high temperature
Weight of dew collected on skin sufficient to prevent flight
Compression tank
Gas pumped from ballonet into tank under pressure for ballast

So well is a dirigible balanced that one man can hold it to the ground when it has its crew on board. It even becomes impossible to start a flight in the early morning after a heavy dew fall, as the weight of the dew is too heavy to permit the ship to "take off." Illustrations at the right shows the effect on ballonets of the difference in temperature. Gas under compression is used as ballast.


Position at given point
Position traveling against wind
Position in still air
Position at given point
Position in still air
Position traveling with wind
Dirigible entering low temperature of clouds
Dirigible regains altitude due to expansion of gas upon entering warmer air
Elevators used to correct sudden change
Contraction of gas causes loss of altitude

The above diagram illustrates how the wind affects the flight of a dirigible. The shaded illustration shows the position of the ship traveling with and against the wind. Notice how this varies with respect to the starting point. It is remarkable to see how rapidly a dirigible will sink when it gets beneath a cloud. The heat from the sun is cut off, the gas contracts, and buoyancy is greatly lessened almost instantaneously. This drop is partially corrected by the elevating planes.

— William P. Sullivan, Aeronautical Engineer.

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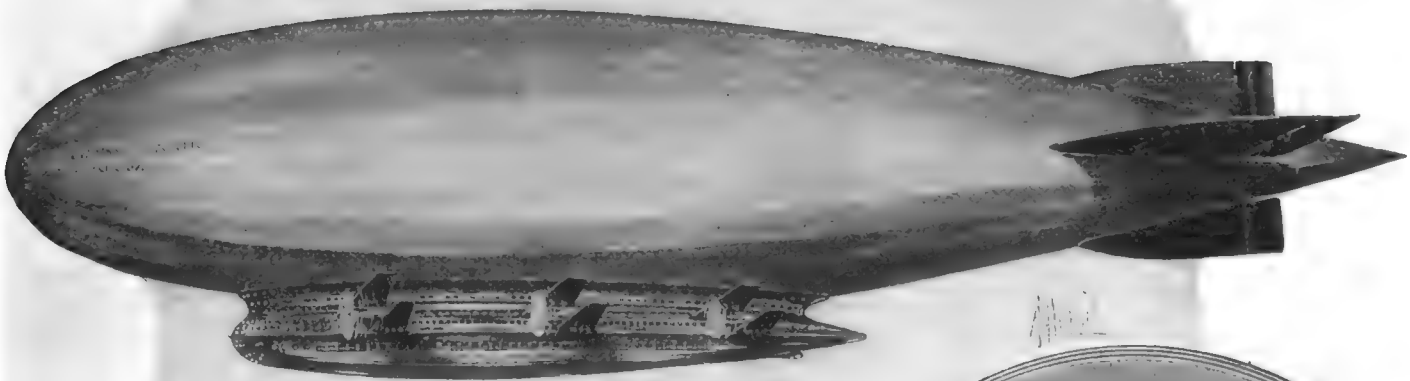
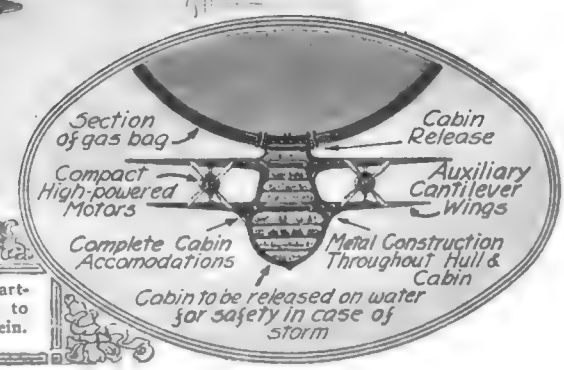
Safety Dirigible of the Future




Section of gas bag
Cabin Release
Compact High-powered Motors
Auxiliary Cantilever Wings
Complete Cabin Accomodations
Metal Construction Throughout Hull & Cabin
Cabin to be released on water for safety in case of storm

If trouble develops with the gas bag of the future dirigible, the passenger and engine compartment can be released therefrom and will volplane to earth. The wings may be flexible to assist with steering and rising and the compartment will float on water. —J. Von Stein.

Airship Moored to Boat

In the April, 1924, issue of SCIENCE AND INVENTION, we published what is known among artists as a "wash" drawing showing a large dirigible moored to a structural steel mast which was erected on an ocean going tank ship. This illustration was used in connection with an article by Graser Schornstheimer, our naval writer, dealing with the airship Shenandoah and is reproduced at the left. At that time, this mobile anchorage for a dirigible had never been built, but was merely in a theoretical stage. However, the tanker Patoka has recently been converted and its appearance differs very little from that set forth in our article many months ago. The photograph directly below is one taken at sea under actual working conditions and shows the Shenandoah moored at her ocean base. What's more, SCIENCE AND INVENTION was the first to publish such a picture.

Photo Times Wide World.

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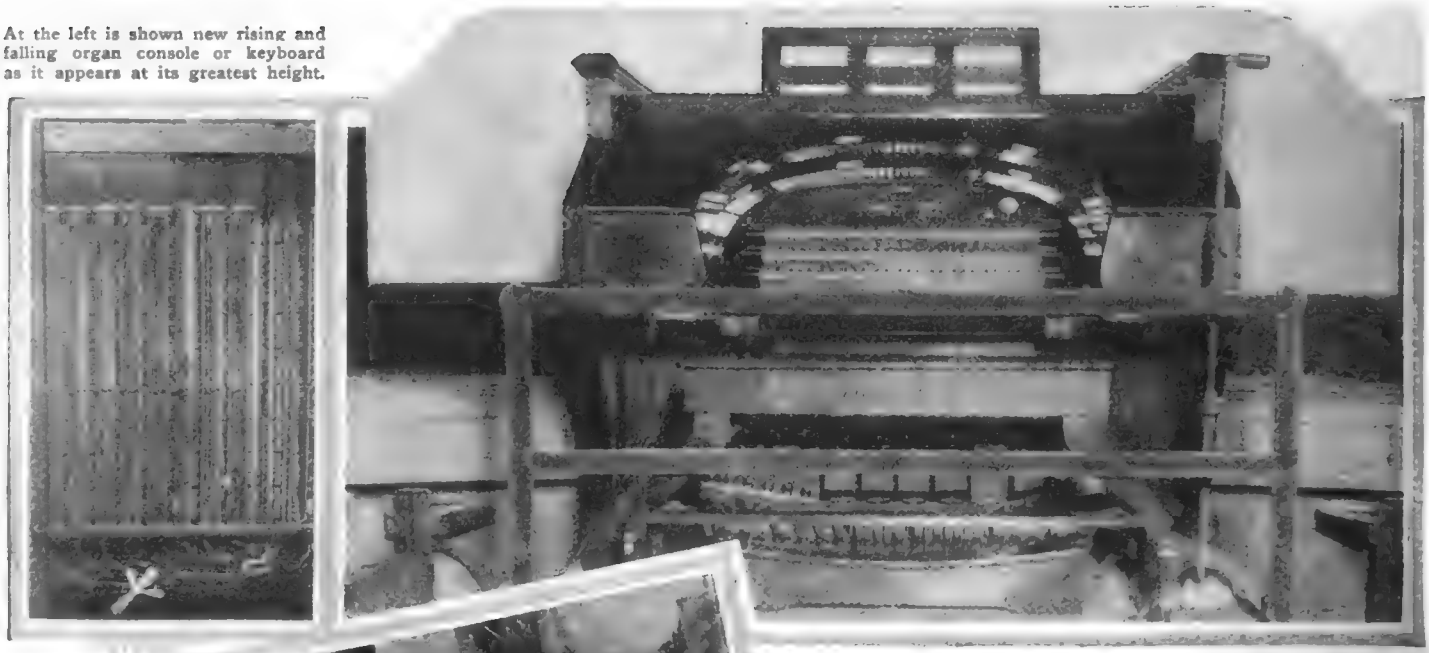
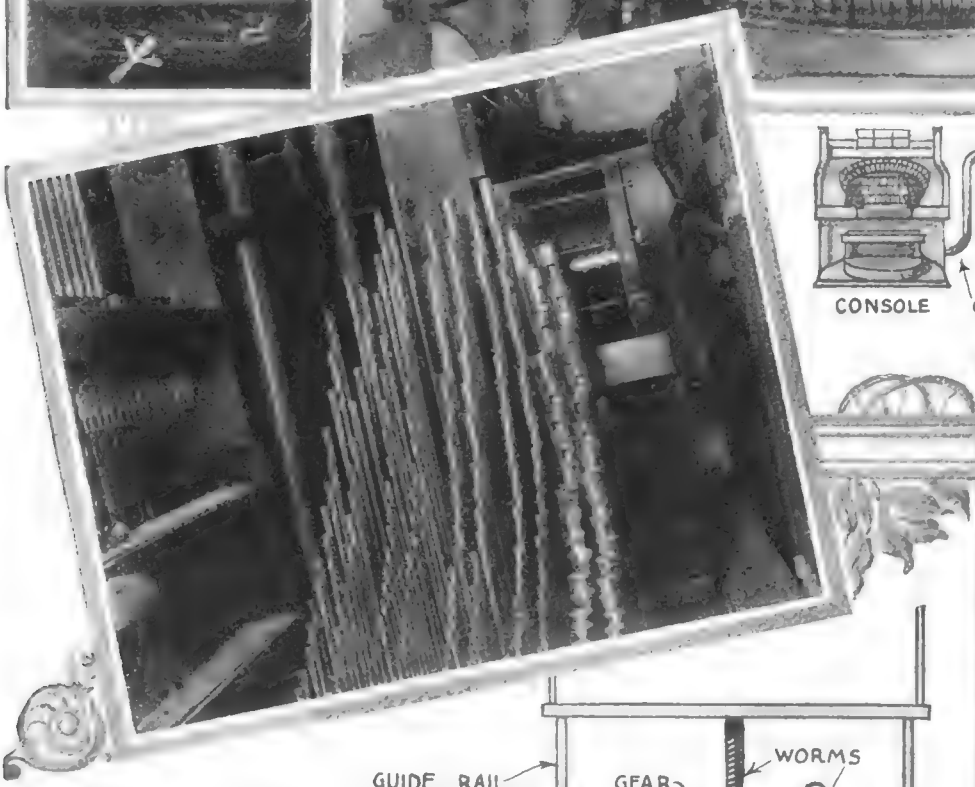
Movable Organ Keyboard

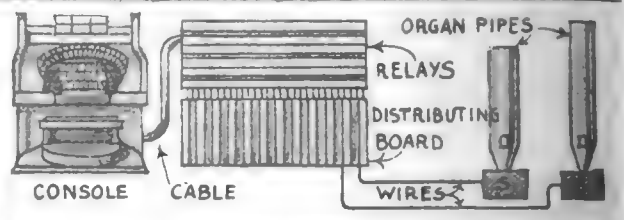
By A. P. PECK

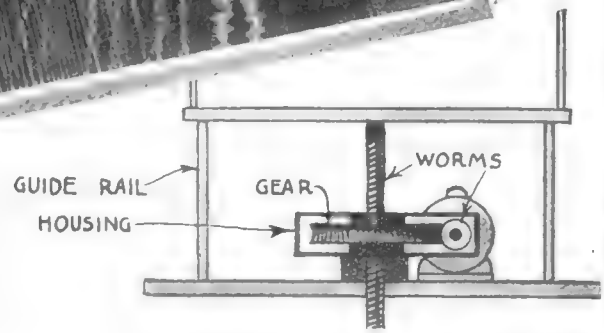
At the left is shown new rising and falling organ console or keyboard as it appears at its greatest height.





The photograph in the upper lefthand corner illustrates a very small section of the enormous distributing board used in connection with the electric organ described on this page. The photo directly above shows a part of the hundreds of pipes that are used as well as some of the traps.





A powerful electric motor and a series of worm gears are used to raise and lower the organ console or keyboard as shown above.

Relays are used to close the main circuits of this electric organ. A section of the relay board is shown directly above.

ONE of the most novel and interesting organs ever constructed is the one which was recently installed in the Piccadilly Theatre, New York City. Several views of the console of this organ and of the various other parts are shown above.

The most interesting fact in connection with this musical instrument is that the console control or key board may be raised or lowered as desired. The purpose of this is to enable the organist to give solos in full sight of the audience. To do this, the console is raised to its fullest height as shown at the top of this page, whereupon the organist is almost at a level with the stage floor. When motion pictures are being shown or the stage is occupied by other artists, the console is lowered. Flexible electric cables make it possible to keep the organ in operation at all times, whatever the position of the keyboard.

The simplified diagram shown at the center right of the page gives an idea of how the circuits are wired. The cable from the console connects to a series of relays which make and break a circuit which carries the great amount of current necessary for operating the pipe mechanism. The relays are in turn wired to the distributing board from which connections extend to the pipes. The latter are supplied with air by means of an electrically driven pump, the flow of air being controlled by solenoids.

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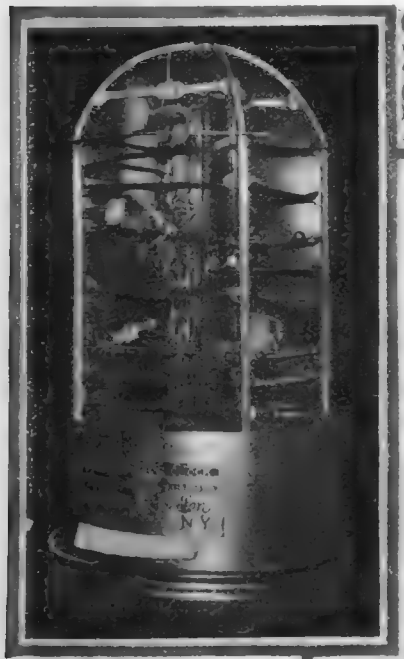
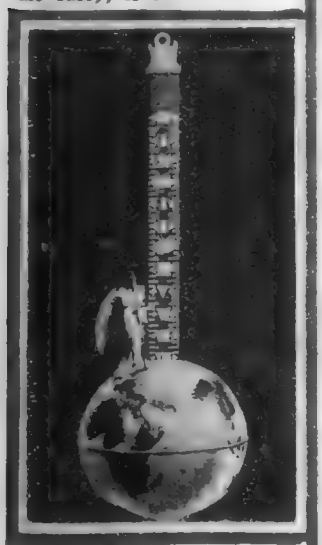
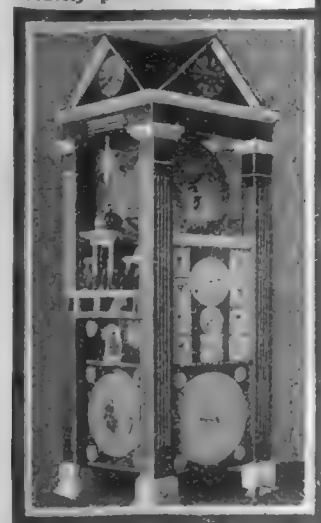
Unique Clocks

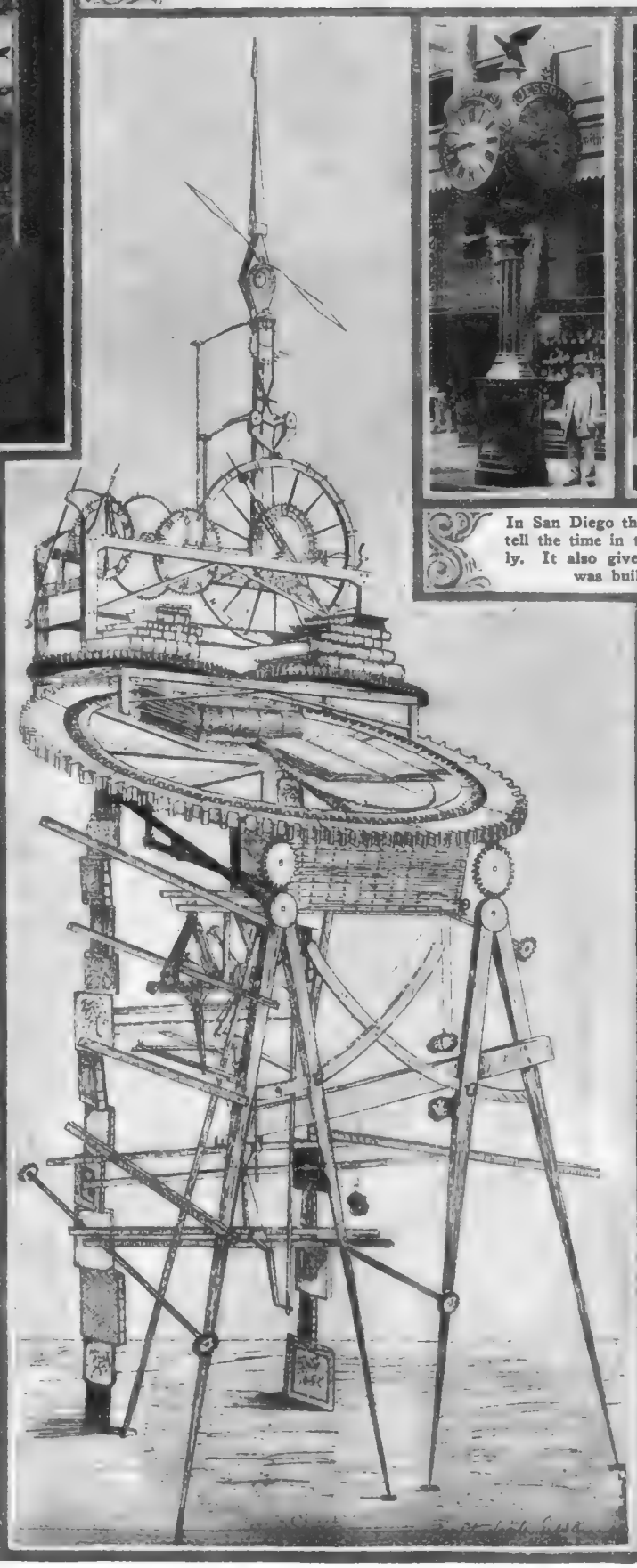


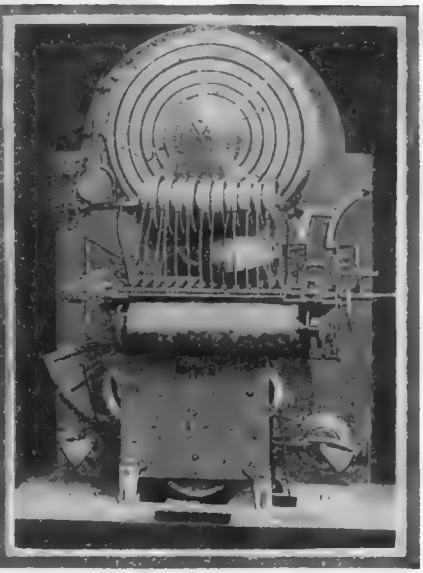
The Fred W. Jensen and Son perpetual motion clock (with a motor concealed in the base), is shown above.



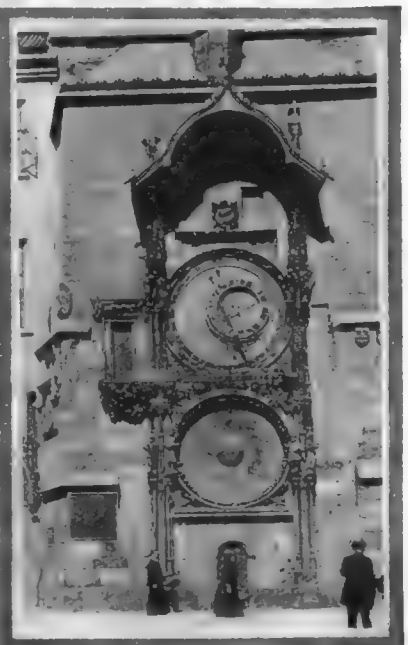
The ball clock above tells time by the pointing of the figure at the parchment strip. Gravity pulls the ball down



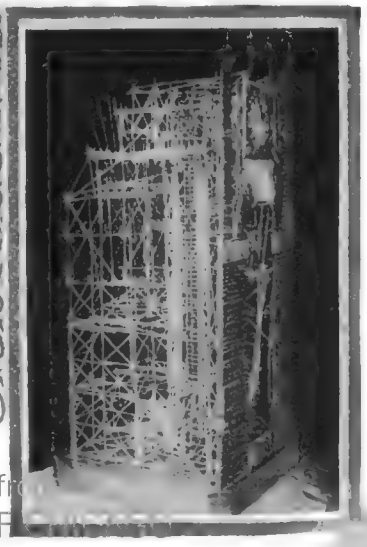




In San Diego there is a street clock with twenty dials which tell the time in the principal cities of the worl simultaneously. It also gives the day of the week and the month. It was built entirely at a retail jewelery store.



Town Hall clock at Prague, Czecho-Slovakia, was built in 1430. It shows mean time, Sideral time, and position of sun. —Slouka.



The above illustration gives a view of the famous John Muir clock, which the naturalist used to light his fires in the morning and to regulate his study periods at night by passing the various text-books he was using before him at the proper time. A large weight hung out the window actuated this device. At the left above is the clock of Frank Fried, which is a monument to five years of patient work. It is ten feet high and three feet square, and has 108 dials showing the time, size, flag, form of government, postage stamp and the lowest coin and the name of the capitol of every country in the world, as well as its language. The globe in the top representing the earth revolves every 24 hours. The moon is shown in comparative size and revolves once every 29½ days. At the left is shown the famous straw clock built by a German which contains nothing but straw. —H. E. Zimmerman.

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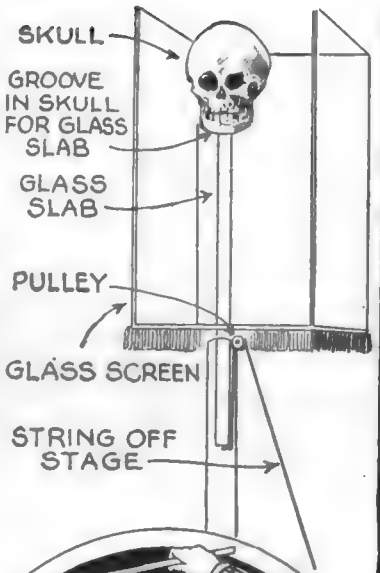
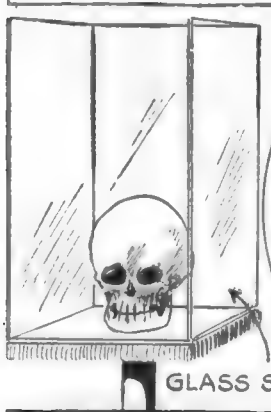
Magic for Everybody

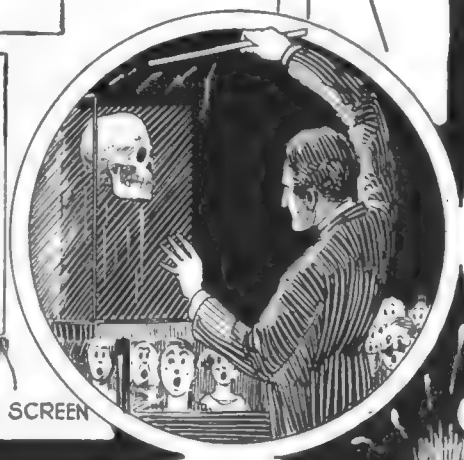
By PROF. JOSEPH DUNNINGER

NO. 22 OF A SERIES

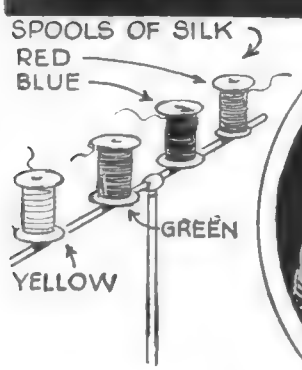
A papier maché skull rests inside of a cabinet made of glass on three of its sides. Front and top are opened. The magician professes to be able to cause the skull to rise and fall at command, and the skull promptly obeys his orders. It can be made to answer questions by rising once for "no," twice for "yes." The secret lies in the fact that the skull is mounted upon a glass slab which is perfectly transparent. Attached to the bottom of the slab is a string passing over a pulley, and then to a system off stage. Naturally the bottom of the slab is concealed by the stand upon which the cabinet rests.

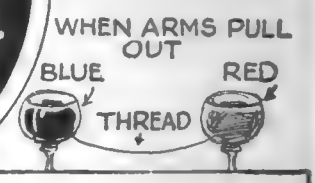




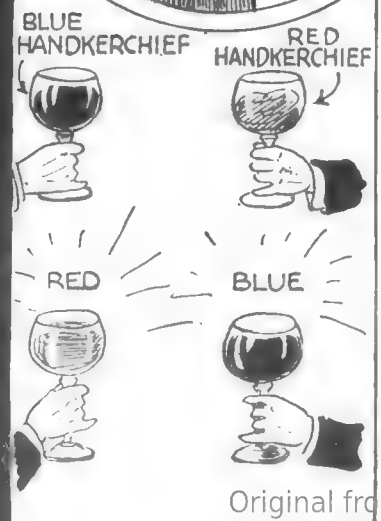


The magician now changes the type of his performance. He becomes a child again and blows soap bubbles, but the remarkable thing about these soap bubbles is the fact that when they are held near the flame of the candle, they explode. This may or may not be due to the gas in the magician's body; at least, that is the way he explains it. Actually the construction of the pipe has much to do with the exploding soap bubbles. Inside of the pipe one will find a small sponge soaked in gasoline. When the bubble is blown, gas fumes permeate its interior. Holding a candle near the bubble ignites the fumes as they are released, when the bubble bursts.





To demonstrate that the magician is likewise an expert weaver, he places several spools on a stand. There are varicolored threads on the spools one being red, another blue, a third green, etc. Picking up one of the spools, the magician proceeds to demonstrate how expertly he can weave the thread into a silk kerchief. He unwinds the thread from the spool slowly, curling it about his fingers, and finally withdraws a similarly colored kerchief. The secret lies in the construction of the spools, which contain the kerchiefs and which have a small lever and spring, permitting the kerchief to drop into the hand when it is released.



The magician holds two glasses in his hands. One of these glasses contains a red handkerchief and the other a blue one. He now causes the kerchiefs to visibly jump from one glass to the other, exchanging places. He merely raises his hands slightly and draws them apart, and presto! the exchange is made before the very eyes of the onlookers. In preparation two holes are drilled in the bottoms of two tumblers, and a fine silk thread tied to the blue handkerchief is passed through the glass containing the red handkerchief, then through the glass containing the blue handkerchief, and finally tied to the red handkerchief, as illustrated.

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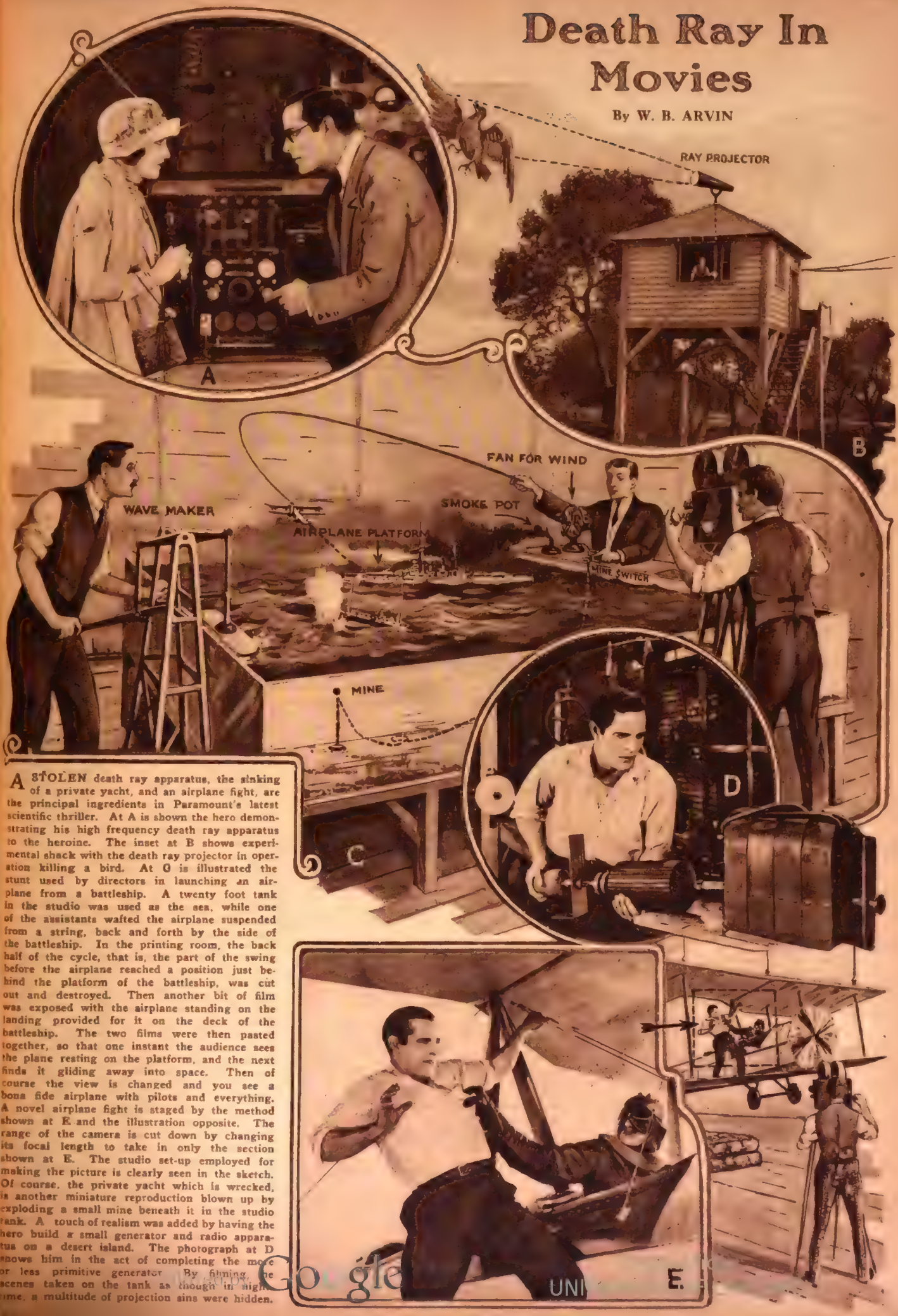
Death Ray In Movies

By W. B. ARVIN



A STOLEN death ray apparatus, the sinking of a private yacht, and an airplane fight, are the principal ingredients in Paramount's latest scientific thriller. At A is shown the hero demonstrating his high frequency death ray apparatus to the heroine. The inset at B shows experimental shack with the death ray projector in operation killing a bird. At C is illustrated the stunt used by directors in launching an airplane from a battleship. A twenty foot tank in the studio was used as the sea, while one of the assistants wafted the airplane suspended from a string, back and forth by the side of the battleship. In the printing room, the back half of the cycle, that is, the part of the swing before the airplane reached a position just behind the platform of the battleship, was cut out and destroyed. Then another bit of film was exposed with the airplane standing on the landing provided for it on the deck of the battleship. The two films were then pasted together, so that one instant the audience sees the plane resting on the platform, and the next finds it gliding away into space. Then of course the view is changed and you see a bona fide airplane with pilots and everything. A novel airplane fight is staged by the method shown at E and the illustration opposite. The range of the camera is cut down by changing its focal length to take in only the section shown at E. The studio set-up employed for making the picture is clearly seen in the sketch. Of course, the private yacht which is wrecked, is another miniature reproduction blown up by exploding a small mine beneath it in the studio tank. A touch of realism was added by having the hero build a small generator and radio apparatus on a desert island. The photograph at D shows him in the act of completing the more or less primitive generator. By filming the scenes taken on the tank as though in night time, a multitude of projection sins were hidden.

Google

The Living Death

By JOHN MARTIN LEAHY

FOURTH INSTALLMENT

Our boasted common sense often leads to near disaster. Tesla, Watt and Columbus are among those who succeeded only after fighting it.

SYNOPSIS

The story opens with Captain Livingstone, imploring the aid of Darwin Frontenac, a famous scientist who has recently discovered methods of inducing hibernation in mammals. The Captain wants Frontenac's help in connection with a discovery he made during an exploration trip to the Antarctic. Before the Captain launches into his story leading up to the final details concerning the exact help he wishes, Frontenac revives a fish which has been frozen several days in a bucket of water, bringing the fish back to life. Several times in his plea the Captain has mentioned "her," also it is known that he wishes Frontenac's assistance in connection with his knowledge of the hibernation of mammals.

The Captain surprises Frontenac by making further statements relative to life in the Antarctic. The Captain says that certain discoveries that he made during his trip confirmed his beliefs that at one time the Antarctic was tropical and peopled by human beings.

The Captain goes on with his story of his trip. He tells Frontenac how his ship started toward the South Pole and how, far south of the Antarctic Circle they discovered land. Establishing a depot at latitude 85 degrees, they went inland. The air became warmer and to their great astonishment, they discovered a land surrounded by high mountains, the temperature of which was far above the freezing point and where palm trees and luxurious flowers grew. At this point the party divided, Hampden accompanying the Captain. After they explored for a while, they turned toward the direction taken by the other party. Suddenly lying in a pool of gore, they came upon a severed human head. It is that of one of their companions. Nearby they found a note telling how a thing came from above, instantly killed two of the party and badly wounded the third. The latter lived long enough to write the note, then his head, which was found by the Captain, was forcibly removed from his body and his body done away with. The survivors found the other heads but could get no trace of any of the bodies.

Leaving this Garden of Paradise, as they had at first named the spot, the Captain and Hampden journeyed on. Some distance further on they find a cave, which had been recently opened by a landslide. Entering the cave they found the floor to be of thick ice. Suddenly the Captain, with a start and cry, bent over and found embedded in the ice a beautiful young lady, perfectly preserved in every detail. After examination . . .

"'God in heaven,' Hampden cried, 'she isn't dead!'"

CHAPTER XIII

"THAT YOU WILL AWAKE HER!"

"I MADE an exclamation and gazed at him in indescribable astonishment, wondering if I had heard him aright.

"'Not dead?' I exclaimed.

"'Not dead! Captain Livingstone—oh, the poor little kid!'

"'Come, Hampden,' said I. 'What on earth are you talking about?'

"'I know what I am talking about, Captain. I said what I believe, and I say it again: This poor girl isn't dead!'

"'That's absurd!' I exclaimed. 'There she is in solid ice! She can't breathe!'

"I stared at him in speechless amazement. I became suddenly alarmed. What had come over Hampden?"

"'Breathe!' exclaimed Hampden. 'If she could have breathed—or if the air had risen above the freezing point—then she would have died. The ice, the ice!' cried Hampden, beating it with his hand. 'That is what saved her!'

"'Saved her? Yes, it has saved her body from decay, from returning to the elements whence it came. Anyone will grant you that. Saved her? Man, it was the ice that killed her.'

"'No! Saved her! Saved her body and soul! Yes, the soul—the soul too! Captain Livingstone, her soul is still there!'

"I was now really alarmed, but worse (so I thought it) was to follow.

"'Come, come Hampden,' I said, 'let us consider this matter carefully, soberly. Here she is in solid ice; here she has been lying—just as we see her now—for thousands of years; and yet you say she is still alive!'

"'Captain Livingstone,' said he very earnestly, 'I didn't say she is *alive*.'

"'Heaven help us! A moment ago you said that she isn't dead, and now you say that she isn't alive. I wish, Hampden, that you would tell me plainly what you really mean.'

"'I have told you. I said that this girl is not dead; that is what I meant. I said she isn't alive; that, too, is what I meant. In other words, she is *neither alive nor dead*—if you know what that means. That is why she doesn't have to breathe.'

"'If I know what that means. I'm afraid, Hampden, that I do know what that means. To be perfectly frank with you, I will say that I wish you would stop talking nonsense.'

"'You think then,' he said, and he said it

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Encrusted for ages in a solid cube of ice the Sleeping Beauty lay in state in her cave awaiting some one to awake her.

pretty testily, 'that I am touched in the head? Well, after all, the fault is largely my own. I should have explained, seeing that you are not aware of the scientific possibilities that one may——'

"'There, there, Hampden,' I interrupted, 'we will just let those scientific possibilities be for the present, and we will concern ourselves with facts—plain, palpable facts.'

"He said nothing to this.

"'In the first place,' I said, 'do you realize how old—how very old!—our Sleeping Beauty must be, how long she has been lying here in this ice?'

"'I think I do. When she lived, this Antarctic land had a warm climate, perhaps even a tropical one, and then suddenly the Great Cold fell—suddenly, instantaneously, as the great Cuvier believed.'

"'And she has been lying here through all the ages that have followed: you have not forgotten that?'

"'Forgotten it? How could I have forgotten that she has been here for ages?'

"'Thousands of years: probably a hundred thousand years, Hampden; and yet you say she is not dead!'

"'Think of the time, Captain Livingstone? For time alone can never touch her, there in her bed of crystal. Ten million years, a hundred million, a thousand million years, and she would be even as we see her now—if this ice that holds her in were never disturbed. Age could follow age, eon follow eon, through all the eons of the coming eternity, and yet time alone could never lay its stain upon her or loose the soul from her body!'

"'If the soul is still there!'

"'Yes; if the soul is still there—as I truly believe that it is.'

"'I see, though,' he added, 'that I must explain.'

"And this he proceeded to do. I listened intently, doing my level best to understand, but I can see now that I understood but very imperfectly.

"He began with estivation and hibernation, taking great pains to show how they differed from the artificial suspension of vitality. Catalepsy came next, and of this mysterious condition he told me some very strange and terrible things. Then he went on to describe the effects of certain drugs, of belladonna, mandragora, chloral hydrate and others—how they could produce the perfect semblance of death.

"'And,' said Hampden, 'if the subject, while in that condition of seeming death, were frozen, he could be kept in that state for years, for hundreds of years—thousands. In fact, there is no limit to the time in which a body could be kept in that condition—of *seeming* death, remember.'

"'And yet,' said I, 'not alive!'

"'And yet not alive. That is the thing that must be firmly grasped and fully understood, that the body, whether that of a fish, a frog or a human being—it doesn't matter what—is neither alive nor dead.'

"'I'm afraid,' I told him, 'that I can't see that.'

"And I'm afraid, Mr. Frontenac, that I don't see it now.

"'It's just like that mathematical-point business,' Hampden said: 'the mathematical point is nothing at all, and yet there it is. And so it is with the body when animation is completely suspended, as is the case with this poor girl here before us: the soul is not dead, neither is it alive, and yet it is there!'*

"And other things he told me—of frogs and fishes, for instance, being frozen and restored to perfect life.

"I asked him if he had ever seen this thing done. No; he never had, but he had read about it.

"'I'm afraid,' I told him, 'that I am something of a Doubting Thomas, after all. I would like to see that.'

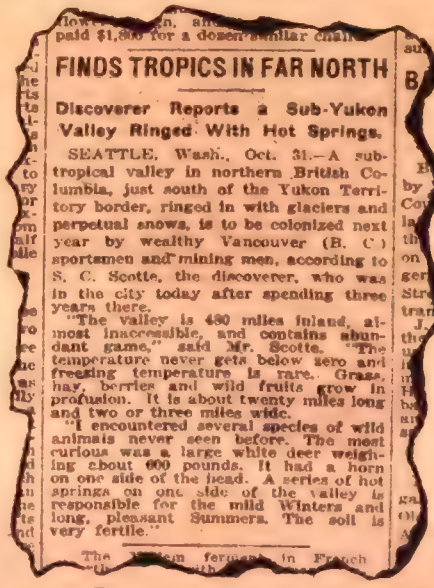
"'There can be no doubt about it,' Hampden said.

"And yet there was doubt about it, for I—in my ignorance and cocksureness—doubted it, just as the world was to doubt me. So it goes, so it goes. And not only that, but I doubted, so to speak, Hampden himself. For I couldn't get the idea out of my thick skull that the sight of Sleeping Beauty had—why, how, I couldn't imagine—affected poor Hampden's head. God forgive me. I see now how wrong I was.

"'But,' I objected, 'a human being is not a frog or a fish.'

"'Don't you see, Captain Livingstone; don't you see?' said Hampden. 'The girl was drugged, and, while she lay here insensible, in that state of seeming death, the Great Cold fell and she was frozen, incased in ice. And so she has remained (not dead and yet not alive) through all the ages that have followed.'

(*Continued on page* 933)



FINDS TROPICS IN FAR NORTH

Discoverer Reports a Sub-Yukon Valley Ringed With Hot Springs.

SEATTLE, Wash., Oct. 31.—A subtropical valley in northern British Columbia, just south of the Yukon Territory border, ringed in with glaciers and perpetual snows, is to be colonized next year by wealthy Vancouver (B. C.) sportsmen and mining men, according to S. C. Scotte, the discoverer, who was in the city today after spending three years there.

"The valley is 480 miles inland, almost inaccessible, and contains abundant game," said Mr. Scotte. "The temperature never gets below zero and freezing temperature is rare. Grass, hay, berries and wild fruits grow in profusion. It is about twenty miles long and two or three miles wide.

"I encountered several species of wild animals never seen before. The most curious was a large white deer weighing about 900 pounds. It had a horn on one side of the head. A series of hot springs on one side of the valley is responsible for the mild Winters and long, pleasant Summers. The soil is very fertile."

What the explorer recently found in the Arc- is depicted in the above excerpt from the New York Times.

*"If change be essential to our idea of life, it may be asked what is the condition of a seed, which may remain unaltered during a period of many centuries; vegetating at last when placed in favorable circumstances, as if it had only ripened the year before. Such a seed is not *alive:* for it is not performing any vital operations. But it is not dead, for it has undergone no disintegration; and it is still capable of being aroused into active life, by the application of the appropriate stimuli. The most correct designation of its state seems to be *dormant vitality*. The condition of an animal reduced to a state of complete torpidity and inaction is precisely analogous; into such a condition, the frog may be brought by cold, and the wheel-animalcule by desiccation."—Dr. Carpenter.

Google

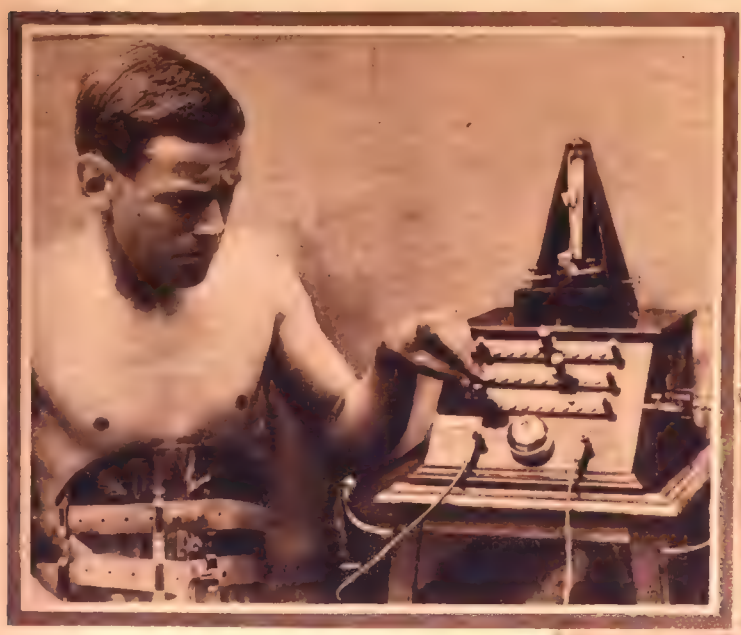
Science PICTORIAL

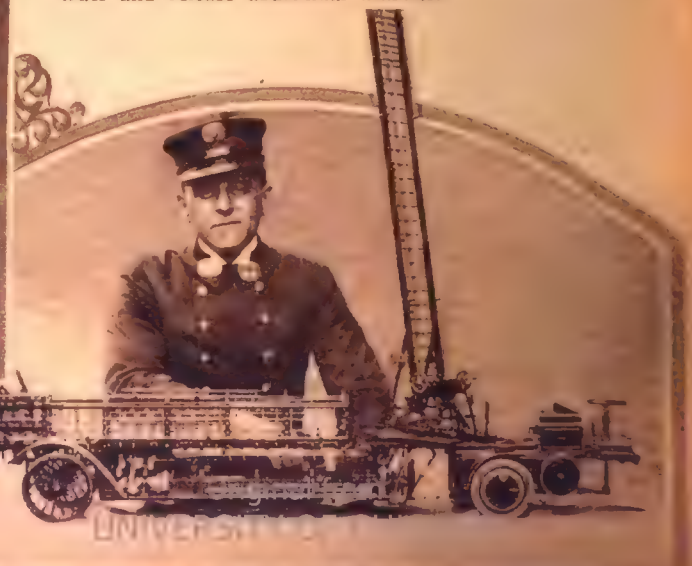
BEFORE science finishes, the life of the crook will be a hard one. Vide the Epidactyloscope, the latest bit of engineering brought to the aid of the police; the machine in spite of its long name is comparatively simple. It is nothing more or less than a device for enlarging finger-prints, so that the identification of criminals can be made swift and easy.

At the right we have Dr. Charles Hunt, inventor of the "Whirling Dips." This machine is just another of those devices for installation in the amusement parks guaranteed to give the people their money's worth in thrills. It emulates the wobbly sea thrills of a liner.

The photograph above shows the light of an airplane flare for illuminating its landing.

Even the Bureau of Standards has taken up the very serious question as to just exactly what constitutes the qualifications of good automobile driving. In this particular instance they have developed a machine for testing automobile brakes. It is shown in the above photograph. The indicator is attached to the brakes and through a system of levers shows directly on the dial just the number of feet required to stop the car from twenty miles an hour speed. At the left is given the latest scientific lead to sufferers of indigestion. The apparatus was invented by Professor Bergonie, and consists of a system of electrodes and switches to contract and release abdominal muscles.





During his spare time Captain John T. Fehl, of the Jersey City, N. J., Fire Department, filed out of solid brass the exact replica shown at the right of his fire company's hook and ladder wagon No. 1. The details are perfect in every respect and the apparatus is entirely workable, the only difference between the model and original being that the former works by electricity.

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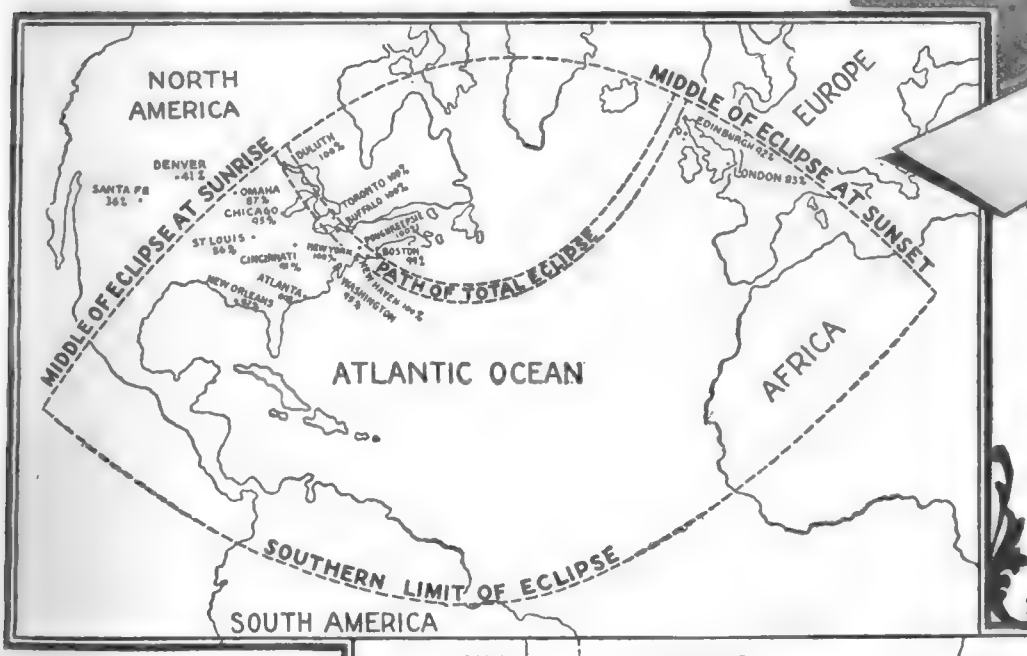
The Solar Eclipse of Jan. 24th, 1925

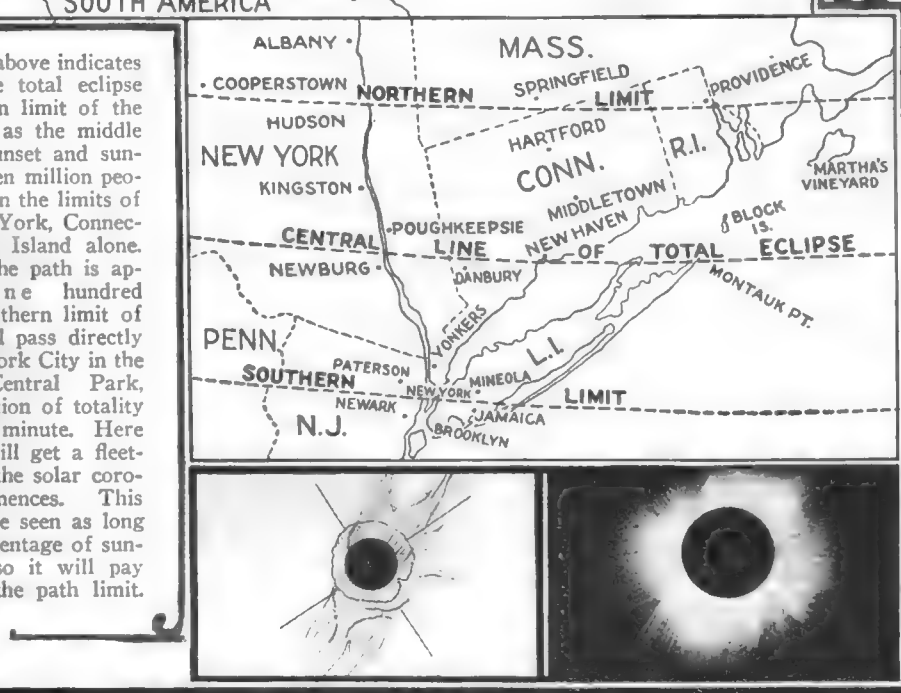
By ISABEL M. LEWIS, M.A.,

OF THE U. S. NAVAL OBSERVATORY

You can be of great help to science if you will make observations during the eclipse of Jan. 24, 1925. Observations of the shadow bands indicated on the right, and the directions in which they move, should also be made. They appear a few moments before and after totality. Astronomers are not entirely agreed as to the cause of the shadow bands, but they are generally conceded to be an atmospheric effect. A sheet should be stretched on the ground, and when the phenomenon first appears, a rod should be laid upon the sheet parellel to the direction in which the bands are moving. Note the width of the bands, their velocity, and whether they travel singly or in groups, when they first appear and disappear, and any other facts of interest.



The diagram above indicates the path of the total eclipse and the southern limit of the eclipse, as well as the middle of eclipse, at sunset and sunrise. Probably ten million people will be within the limits of eclipse in New York, Connecticut and Long Island alone. The width of the path is approximately one hundred miles. The southern limit of total eclipse will pass directly through New York City in the vicinity of Central Park, where the duration of totality will be one-half minute. Here the fortunate will get a fleeting glimpse of the solar corona and prominences. This corona cannot be seen as long as the least percentage of sunlight remains, so it will pay you to get in the path limit.



On Jan. 24th, 1925, there will be a total eclipse of the sun, which may be seen over area shown in diagram illustrated to left. Astronomers have asked all to cooperate with them in observing this eclipse. In the first place, the beginning and end of the total eclipse should be noted with the aid of binoculars or a small telescope, using the necessary protection for the eyes. An accurate chronometer should indicate the time to the nearest second or fraction thereof, when the last ray of sunlight disappears at the beginning of the total phase, and the first ray appears at the end of totality. One should also observe the form, brightness and general appearance of the solar corona which appears only during the total phase of the eclipse, and by all means make a sketch of it, noting whether it is evenly developed all around the sun or has extensions longer in some directions than others. Estimate its extent with the diameter of the moon as the unit of measurement. An example of the way this should be drawn is shown in the photo diagram to the left. Are the short bushy polar rays strongly in evidence? A sun spot minimum type of solar corona is indicated in the photo at the left. Long equatorial extensions of the coronal rays and short bushy rays divide sharply our solar poles like lines of force from a magnet. The sun spot maximum type is evenly developed in all directions. The long equatorial streamers have lacking and so are the short polar rays.

As the moon passes from west to east, the first contact or partial phase of the eclipse begins when the eastern edge of the moon seemingly touches the western edge of the sun. This is illustrated in Fig. 1 reproduced immediately above. In Fig. 2 we see a partial eclipse of the 50 per cent. variety. Here the solar diameter is half covered by the moon. The total eclipse begins when the eastern edge of the moon touches the eastern edge of the sun. This is the second contact, then the third contact takes place, when the western edge of the moon separates from western edge of the sun. This is the ending of totality. The last contact occurs when the moon separates from the eastern edge of the sun. This latter illustrated in Fig. 5 is the ending of the partial eclipse. "Baily's Beads" are a peculiar phenomenon which appear just after the third contact or the end of totality, and may also be seen just before the second contact or beginning of totality.

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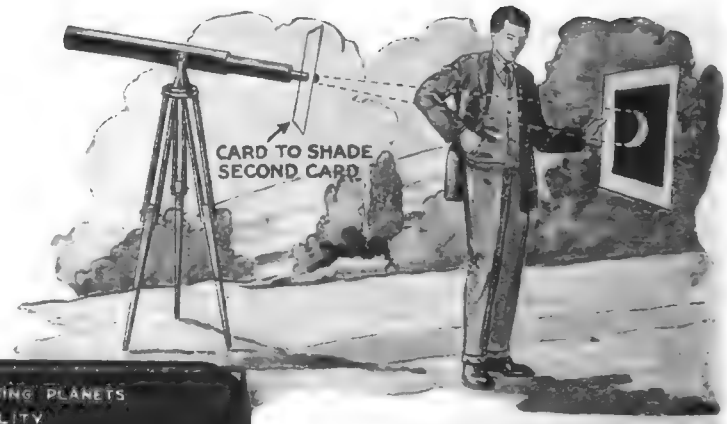
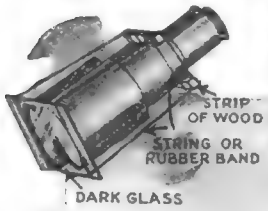
Methods for Observing Eclipse

By DONALD H. MENZEL, Ph.D.

THERE are a number of simple methods which may be employed for observing this total eclipse. In this connection it might be noted that binoculars, opera glasses, telescopes of even a piece of cardboard with a pin hole may be worked into the business of observing an eclipse. For the half minute or more during totality, stars will be visible in the heavens. The sketch immediately below shows those which will be brightest. They will be plainly visible for twenty or thirty seconds. At the right is depicted a method for projecting a picture of the eclipse upon a piece of cardboard. This method will be found exceptionally useful where a large number of people are making an observance together. A small card is placed around the eye-piece of the telescope at right angles to it. Another card is held at the proper distance behind the telescope, so that the image of the sun is clearly projected upon it.

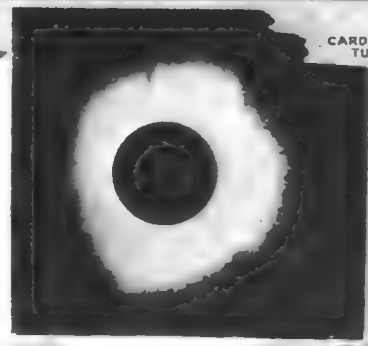


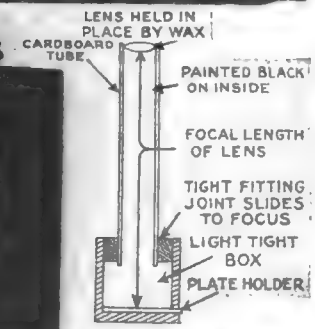
In using binoculars or other optical instruments for observing the eclipse, do not smoke the lenses themselves, but use a dark glass as shown below.



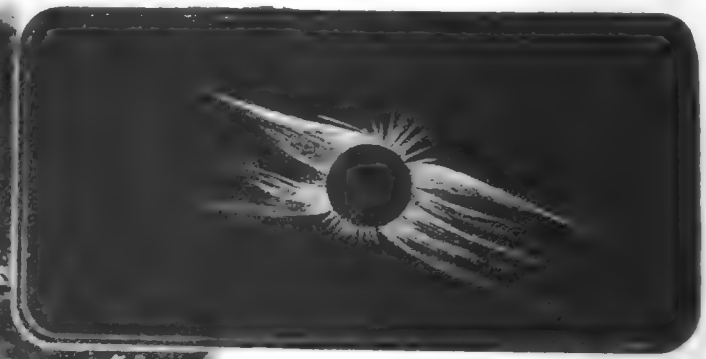
METHOD OF FIXING DARK GLASS ON FIELD GLASSES

In observing the eclipse, the best form of smoked glass to use is an over-exposed photographic plate. A smoked glass may be made by smoking it with camphor or candle and binding a second sheet of glass over the smoked side to protect it.





IF IT is desired to photograph the solar eclipse, a serviceable celestial camera may be constructed as shown in the small sketch at the left. A cardboard tube is painted black on the inside and attached to a light-tight box, in which the photographic plate is placed. The device must be experimentally focussed with a ground glass before time for the eclipse. Exposure may be controlled by placing a cap over the top of the lens. Another method for projecting the eclipse is shown in the lower left corner. A pin hole is placed in the center of a large cardboard sheet and the image so created, allowed to fall on a second cardboard sheet, as shown in the sketch. A little experimentation will show the proper distance at which the two cards must be separated in order to obtain a clear cut image. In making the lens camera, it will be necessary to have the distance from the lens to the photographic plate equal the focal length of the lens, and remember that the photographic focus is equal to the visual focus as measured on the ground glass, less the thickness of the ground glass.



A CORONA will undoubtedly be visible at the instant of totality. No information will be available, however, as to what form it will take. The photograph above shows a corona which occurred at a sun spot minimum. The streamers may extend three million miles into space from the edge of the sun. No prediction has been made yet as to what may be expected during the forthcoming eclipse. In the center is shown another form of corona occurring when the sun spots were near the maximum. Note the complete absence of long streamers. When the sun spots are at a maximum, the corona is almost regular in shape. The exact connection between the sun spots and the corona is indicated, but the nature and reasons for the interaction are not explained.

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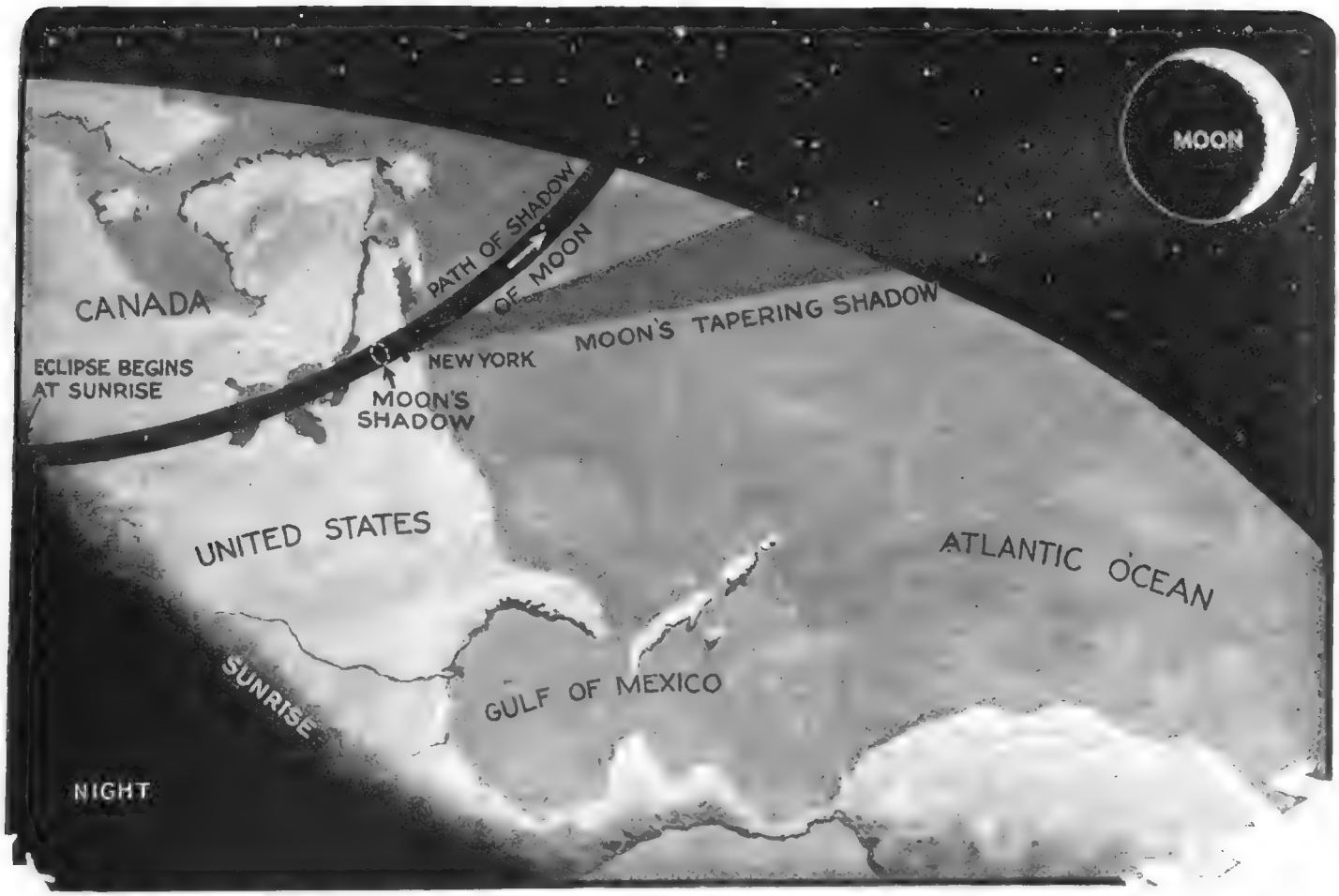
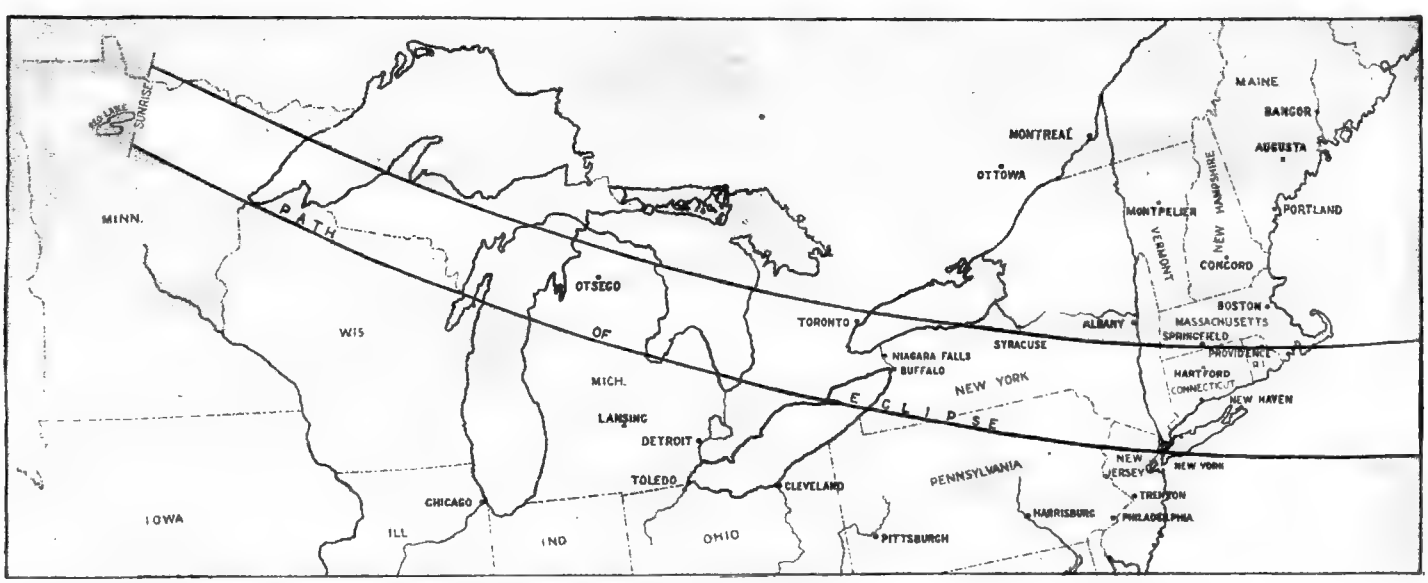
Actual Path of Total Eclipse



FOR the first time in a great many years, a total eclipse of the sun will be visible in the eastern part of the United States on January 24, 1925. In sketching the above illustration, our artist chose an imaginative point in space for his observation. Picture to yourself that you are situated in an airplane thousands of miles above the surface of the earth. Below, and to your left, will be the earth and if you have chosen your time correctly, North America will be in your center of vision. Suspended in space before you will be a large globe, a small portion of which will be illuminated by the sun and the other part will be in shadow (night). This will be the aspect of the moon as viewed from space. As the moon moves on in its path, the tapering shadow which it throws on the earth will follow a narrow path across North America from West to East. At the time of this happening, the earth will be so situated in relation to the sun that the western half of the United States will be in darkness. Therefore, it will be possible to view the total eclipse only from a narrow band which crosses the Eastern United States in the path indicated. Other locations will see only a partial eclipse.



The above map illustrates graphically the path of the total eclipse of the sun from sunrise in the middle west of the United States until the path of totality passes the eastern coast and proceeds out across the Atlantic Ocean. Everyone situated within the above illustrated path will, if the day dawns clear and bright, be rewarded with a view of the total eclipse and for a period varying from .5 to 1.8 minutes, the observer will be in darkness as the eclipse becomes total. The following table gives the time of the beginning of the partial eclipse, the time of the beginning of the total eclipse (middle), and the end as well as the duration of totality.

Place	Start A. M.	Middle	End	Duration
Buffalo, N. Y.	7:59	9:07	10:22	1.8 min.
Geneva, N. Y.	8:00	9:10	10:26	1.5 "
Ithaca, N. Y.	8:00	9:10	10:26	1.8 "
New Haven, Conn.	8:01	9:13	10:32	2.0 "
New York City	8:00	9:11	10:29	0.5 "
Poughkeepsie, N. Y.	8:01	9:12	10:30	1.9 "

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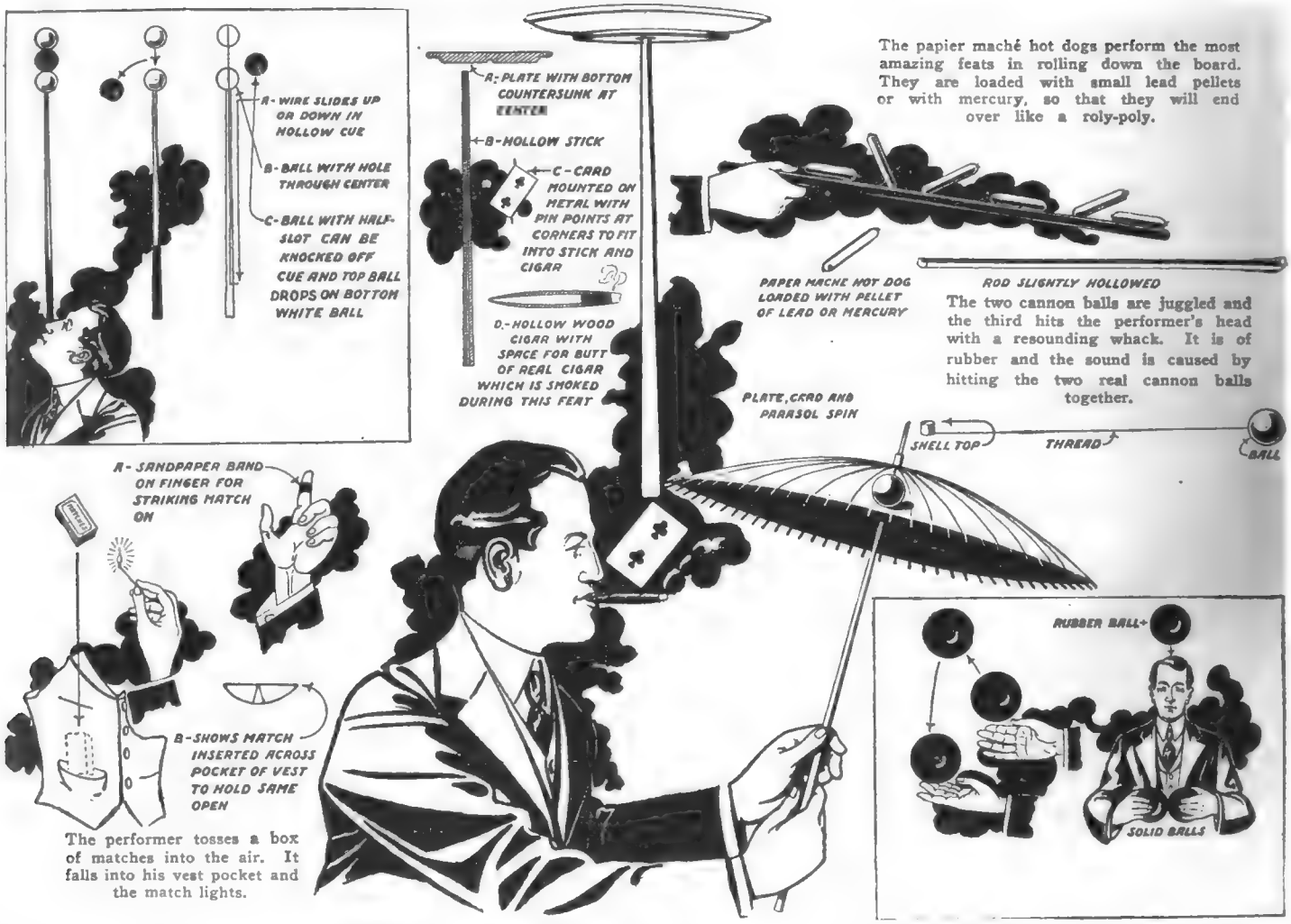
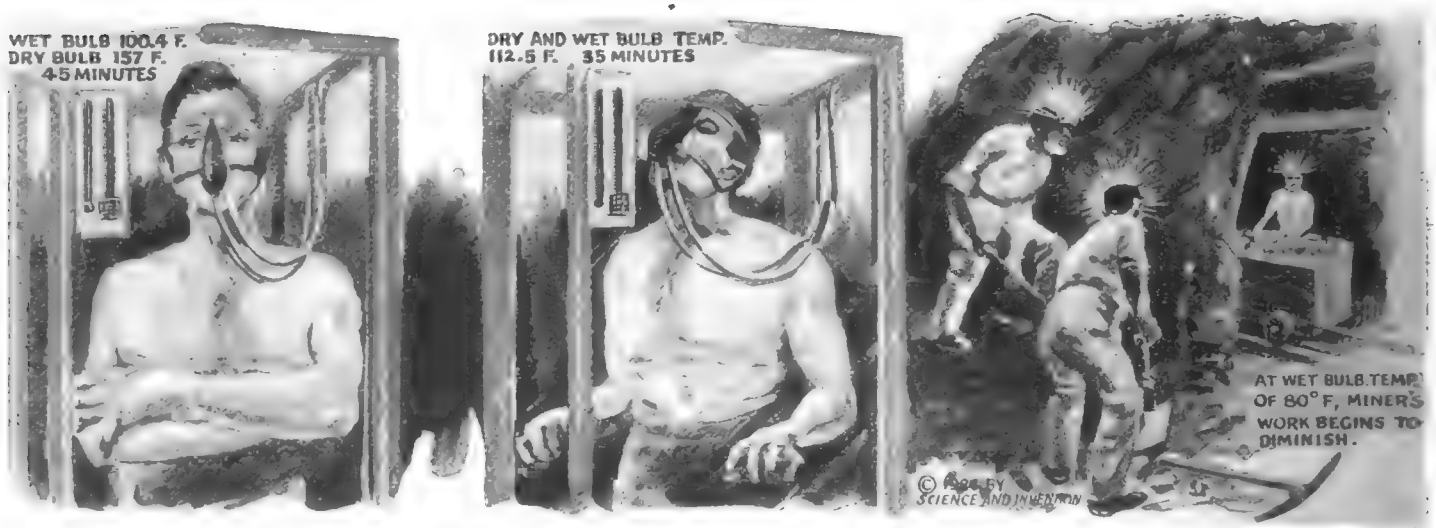
Mystifying Juggler Tricks


A- WIRE SLIDES UP OR DOWN IN HOLLOW CUE
B- BALL WITH HOLE THROUGH CENTER
C- BALL WITH HALF-SLOT CAN BE KNOCKED OFF CUE AND TOP BALL DROPS ON BOTTOM WHITE BALL
A- PLATE WITH BOTTOM COUNTERSUNK AT CENTER
B- HOLLOW STICK
C- CARD MOUNTED ON METAL WITH PIN POINTS AT CORNERS TO FIT INTO STICK AND CIGAR
D- HOLLOW WOOD CIGAR WITH SPACE FOR BUTT OF REAL CIGAR WHICH IS SMOKED DURING THIS FEAT
PLATE, CARD AND PARASOL SPIN
The papier maché hot dogs perform the most amazing feats in rolling down the board. They are loaded with small lead pellets or with mercury, so that they will end over like a roly-poly.
PAPER MACHE HOT DOG LOADED WITH PELLET OF LEAD OR MERCURY
ROD SLIGHTLY HOLLOWED
The two cannon balls are juggled and the third hits the performer's head with a resounding whack. It is of rubber and the sound is caused by hitting the two real cannon balls together.
SHELL TOP
THREAD
BALL
A- SANDPAPER BAND ON FINGER FOR STRIKING MATCH ON
B- SHOWS MATCH INSERTED ACROSS POCKET OF VEST TO HOLD SAME OPEN
The performer tosses a box of matches into the air. It falls into his vest pocket and the match lights.
RUBBER BALL
SOLID BALLS

The stunts illustrated here are all performed with the aid of apparatus, and when worked before an audience will be surprisingly mystifying if done with some degree of perfection. In balancing the billiard balls on the cuestick the stiff wire holds the ball in place. The center ball is slotted so it can fall out. In the stunt illustrated at the center the cigar is a hollow wood cylinder which takes a regular cigar stump. The card is backed with a piece of thin sheet iron and a pin extends from bottom and top. The stick upon which the plate spins is made of some tough light wood and the plate is countersunk at the bottom, to receive the stick. A little practice will be necessary before the three of them can be held perfectly straight. —L. J. Smith.

The Body's Heat Kills


WET BULB 100.4 F.
DRY BULB 157 F.
4-5 MINUTES
DRY AND WET BULB TEMP.
112.5 F. 35 MINUTES
AT WET BULB TEMP. OF 80° F, MINER'S WORK BEGINS TO DIMINISH.
© 1925 BY SCIENCE AND INVENTION

In recent experiments the U. S. Bureau of Mines ascertained that if a man were permitted to breathe, and were so situated that his body could not radiate heat, in a very short time death would result. The above illustrations show graphically some of the results found. It was noted that with the wet and dry bulb thermometers, both reading 112.5° F., the individual could only live for thirty-five minutes. When work is performed, heat is generated and dissipated into the atmosphere. When the surrounding air is too warm to take up the heat, the body perspires and the evaporation of the perspiration dissipates the heat. In the extreme the body cannot adjust itself to a temperature above ninety degrees wet bulb in still air, even though the body be in a state of perfect rest. It is better to work in dry air when the occupation necessitates working at temperature of more than 80° F.

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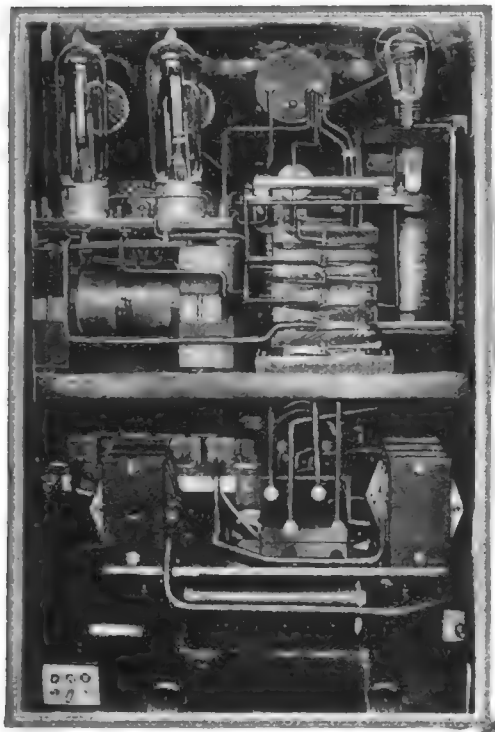
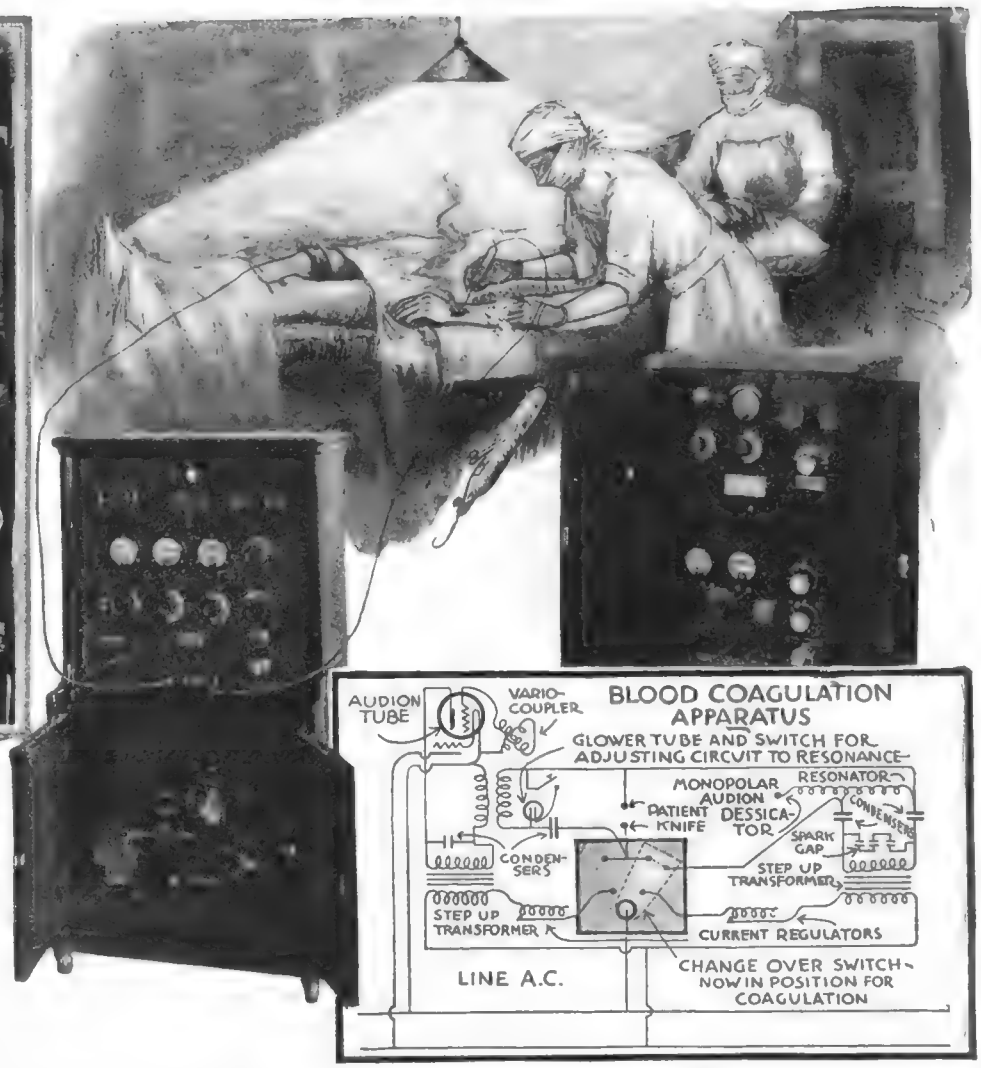
Further Details of Radio Knife

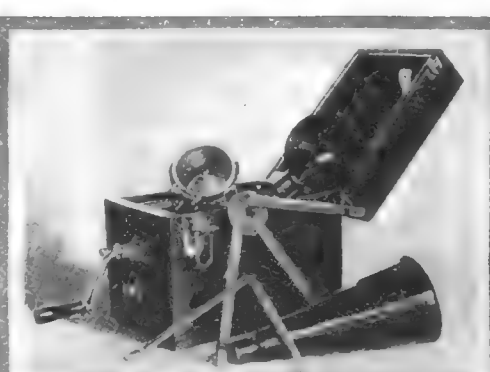




The photo immediately above shows the back view of the "radio knife," and the one at the right shows the front view of the same. Primarily the "radio knife" is an ordinary sewing needle, which by the use of the proper kinds of current, the first consisting of damped oscillations, causes coagulation of soluble protein substances in the blood, and consequently seals the blood vessels, preventing circulation. Cancer or other malignant cells cannot, therefore, find their way into the blood stream from the dangerous growth. In the second circuit the undamped oscillations are produced which also coagulate the blood proteins but to a lesser degree. The distinct property of this current is to cut through the tissues. This cut is absolutely sterile, being performed through the agency of heat, and consequently requires no mechanical effort. The heat produced is due to the resistance of the tissues to the current coming through the fine needle. Healing is rapid and scarless, and the work is done under local anesthesia without danger.

The above diagram shows the circuit of the "radio knife" apparatus. The instrument was developed by Dr. George A. Wyeth and is technically known as the Endotherm. Photos courtesy Wappler Electric Co.

Phonograph Resembles a Box Camera



It looks like a camera but it isn't. The photo at the left shows what appears to be a small box camera. On opening the same, a handle, a collapsible turn-table, a reproducer, tone arm and horn, the latter made in either of two types, both shown above, come out of the box. The turn-table is then placed upon the phonograph, a record slipped upon the same, and the girls in camp have music with their meals, or for their dances.

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More Gambler's Tricks Exposed

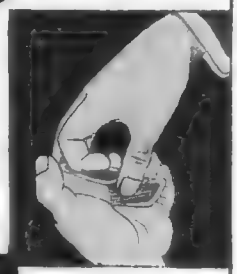
By MARK MELLEN

The Man Who Fooled P. T. Barnum

MANY gamblers who play for big stakes do not like to take chances on being caught with some mechanical device used for gambling. These sharks depend entirely upon their ability to manipulate the deck. They can reverse any man's cut without being noticed and so save their deal. Of course they are thoroughly acquainted with the best methods used to shuffle the cards, and if they can only counteract the cut, can deal themselves perfect hands. Another one of their favorite stunts is dealing from the bottom of the deck. It is very simple and depends principally on dexterity for successful completion. The sketches at the left show clearly how men employing this trick work their trade.

Employment of the methods shown on this page leave the sharp in a particularly good position. There is no absolute evidence of his cheating, except the witness who catches him at it, yet his bag of tricks gives him a sufficient percentage to play his game safely; yes, and to play it with the assurance of coming off with healthy profits in his pocket.

The three figures to the left expose palming. The top figure shows card shoved off deck by left thumb, right hand hiding movement. The second figure shows card retained in right palm, lifted into position by second finger of left hand.



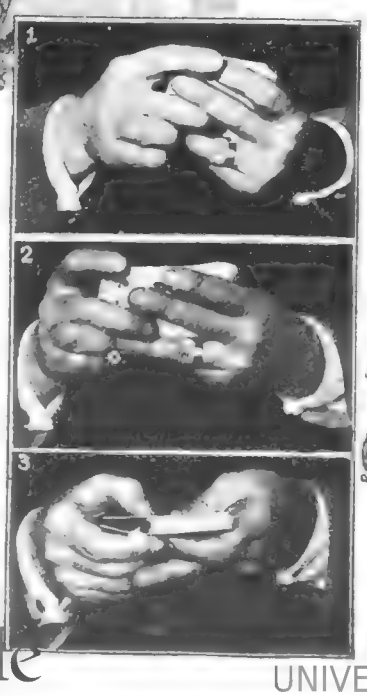
To palm card on bottom of deck, grip corner of under card with left little finger at first joint. Then swing finger end of upper portion of deck out against left thumb. Shown below.

Left — Then release thumb of lower portion of deck, dropping down into left palm, releasing under packet, and slide deck out of left hand and drop it on the table to be cut, turning over left hand containing palmed card.

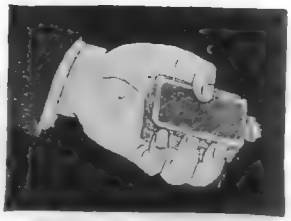
Maintaining the bottom palm while dealing, is done for one of several reasons, but mainly to avoid the risk of replacing the palm immediately after the cut; as a more favorable opportunity occurs just after the deal, when the remainder of the deck is placed on the table. This is of particular service in such games as poker and casino.

ONE BORN EVERY MINUTE
TRIMMING DONE NEATLY BY EXPERTS
GET TRIMMED TO DAY, TO MORROW YOU MAY BE BROKE
THE EASY DOLLAR
ALL WE WANT IS YOUR MONEY
YOU WILL MARVEL AT THE QUICK AND EASY RELIEF
PLEASE DON'T CROWD!

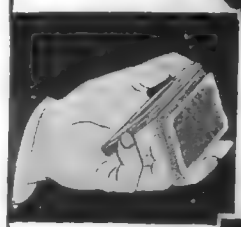
The cards are palmed in the left hand. The fingers of the left hand are kept close together, as at right.



The three figures to the right show how a card is dealt from the bottom of the deck. The second and third fingers of the left hand are spread far apart under the deck. The second finger of the right hand is used, as in second figure, to draw the bottom card off. The left thumb is used to push the top card partly off the deck, thereby camouflaging the real work, as shown in the third figure to the right. In the illustration the hands are held up to reveal the work.



The top figure to the right shows how the sharp holds the location of the cut while dealing. The next figure shows the little finger at one end, the first or second fingers at the side and thumb diagonally across the top of the deck.



Next, to reverse the positions of the two parts of the deck, hold the upper packet firmly by pressing the thumb.

Then press lower packet up and over the top. The little finger aids in getting the under packet over by pulling down on the upper packet when lower one is lifted.

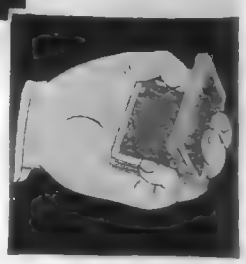


Figure above shows method for "skinning a hand." Separate the upper edges with both thumbs, bend slightly the card that is to be brought up. Then pull out the rest of the cards with the left hand by a backward and inward motion.

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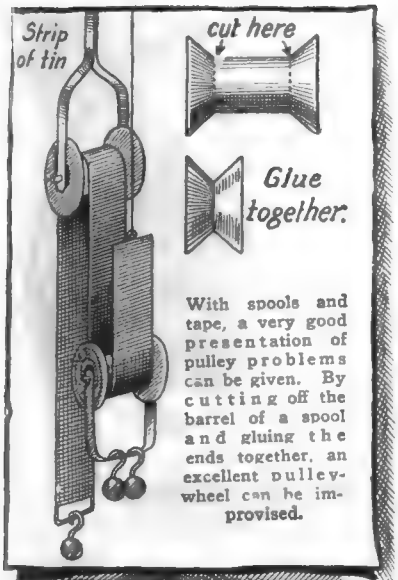
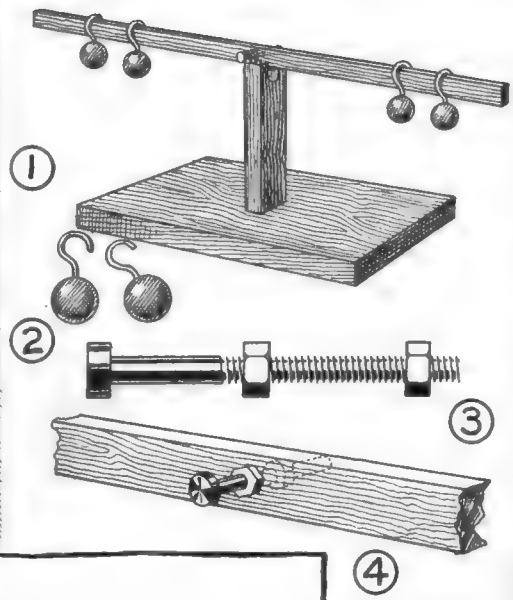
Science Odds and Ends

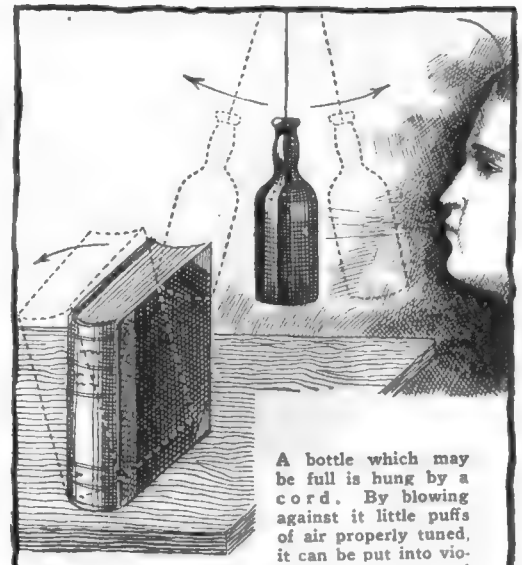
By T. O'CONOR SLOANE, PH. D., LL.D.

Second Installment

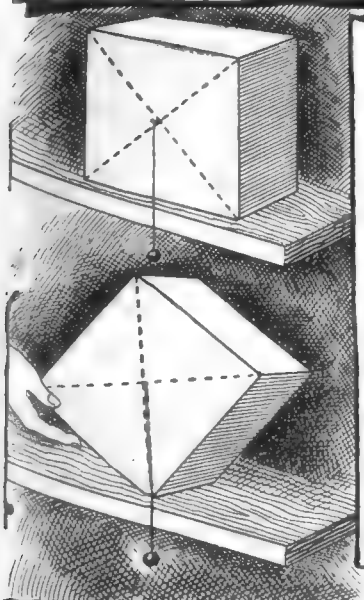


With spools and tape, a very good presentation of pulley problems can be given. By cutting off the barrel of a spool and gluing the ends together, an excellent pulley-wheel can be improvised.



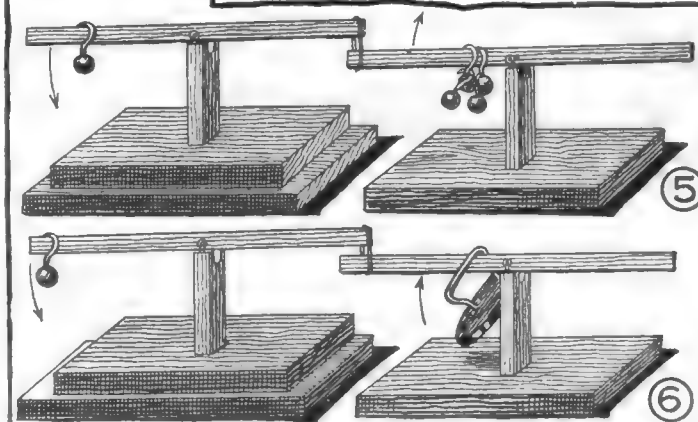


A bottle which may be full is hung by a cord. By blowing against it little puffs of air properly tuned, it can be put into violent swinging. Set up a book in its path and it will be thrown down. You have blown over a heavy book with the breath.



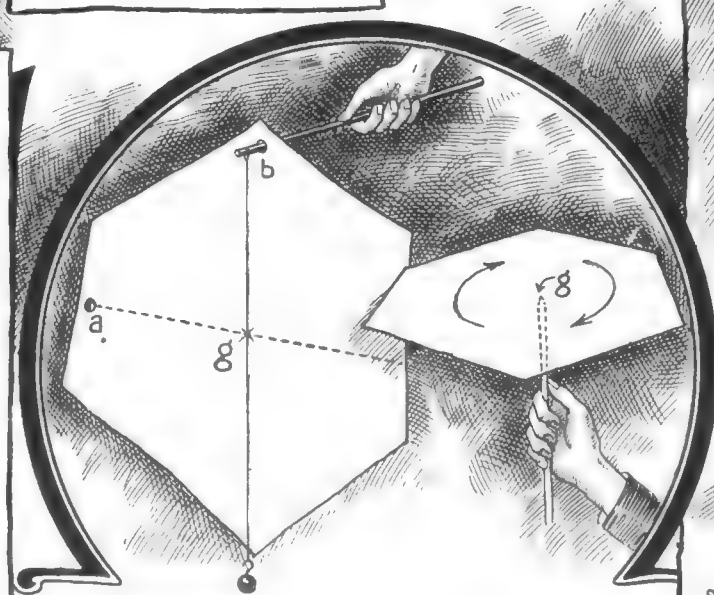
A plumb bob is hung from the line of center of gravity of the box. The latter is gently tipped, and as the cord passes outside the lower corner it falls over.

Levers have their pivots made from bolts with two nuts, as shown in 2 and 3. The lever or an easily made stand is shown in 1. For weights, lead bullets with hooks screwed into them are used.



Further lever experiments. By compounding levers a single bullet will support an astonishing weight.

A bottle is suspended by an India rubber band and twisted. It will turn slowly back and forth for a very long time. It is the torsional pendulum. The pendulum on the left has its frequency reduced by the removable upward extension.



An irregularly shaped piece of pasteboard is suspended by a rod passing through a hole (b). From the rod a plumb bob hangs. A pencil line is made to trace the line of the string. This is done in a second place (a). The intersection of the lines gives the center of gravity (g), and the pasteboard can be spun on a pencil point.

Stand firmly with your side against the wall. The foot must touch the wall too. Now try to take the outside foot in the hand. You cannot do it. The experiments tell you why.

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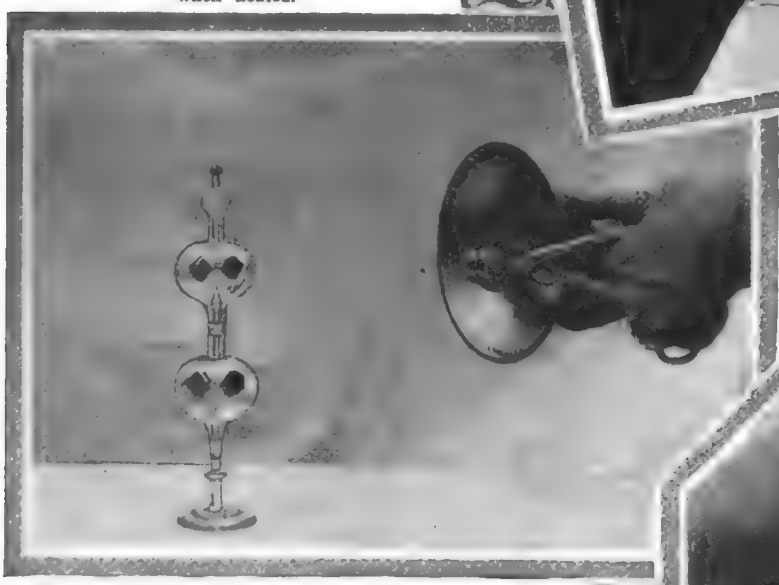
Nature of Heat

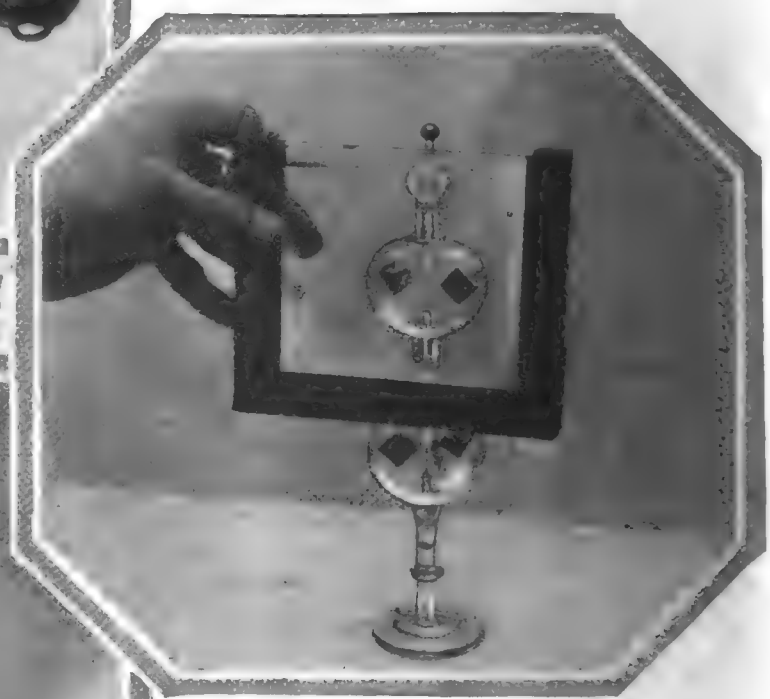
By RAYMOND

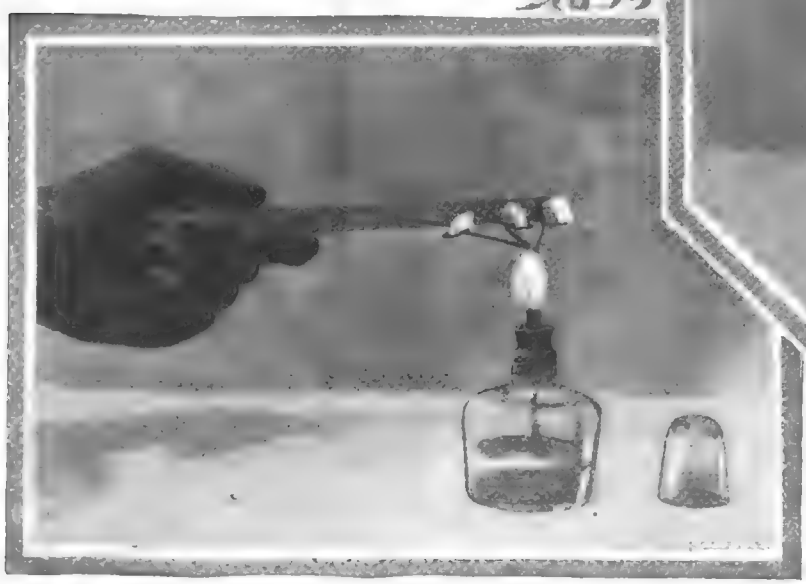
Drop of ink in straw shows expansion of gas when heated.

Glasses often break when hot water is poured into them. This is because the expansion of the glass with the heat of the water is so great that it is pulled apart. Some substances, such as pyrex, and quartz, expand very little when heated. For instance, a quartz vessel may be heated to redness and plunged into cold water without its breaking, because it expands very little with heat. The rate of expansion and contraction in a substance is known scientifically as its "coefficient of expansion."



Heat is reflected in the same manner as light. The lamp shade above reflects the heat rays to the radiometer.





Different substances have a different conduction for heat. The radiometer often shown in the jeweler's window and illustrated in the above photograph can be used very vividly to show this principle. If a solution of alum and water is placed in the glass trough in front of the radiometer, the instrument will immediately slow down in its movements. Different conductivities of metal are shown at the left; wax balls are placed equidistant from the flame on wires of different metals which are heated. They will drop off at different times.

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in Experiments

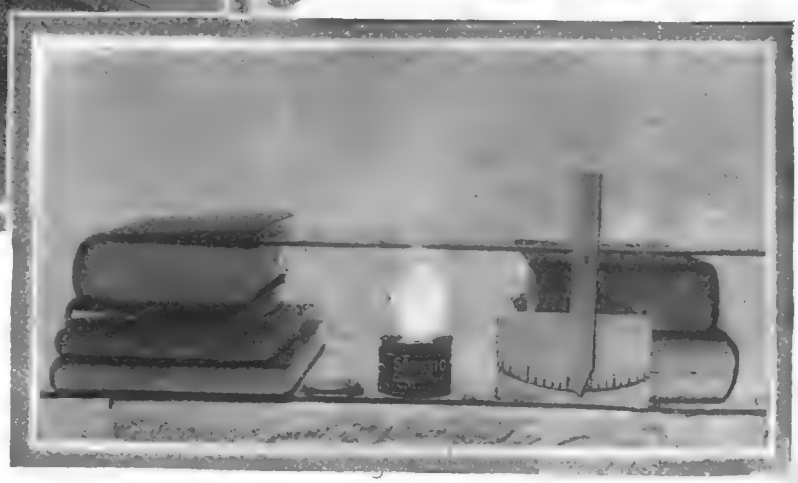
B. WAILES

The convection of air currents is shown above. The candle is placed under one of the lamp chimneys and a piece of lighted paper held over the other. The hot air rises above the candle, pulling the smoke and flame of the paper down through the second chimney. Metal conducts heat better than wood. (See right.) Half a rolling pin is covered with metal foil and then with paper, and the paper lighted. The paper will burn while there is wood under it, but will go out over the metal because the metal dissipated the heat, preventing the paper burning.

Electricity can be made directly from heat. To perform this experiment, twist the ends of an iron and a copper wire together, connecting the two wires to a pair of radio receivers. If the ends of the wires are heated and one of the phone tips is intermittently touched with one of the wires, thus opening and closing the circuit, a series of clicks will be heard in the telephone. This is the principle of the thermo-couple.

That water is a very poor conductor of heat is shown plainly in the experiment at the left. A thermometer is held just under the surface of a bowl of water and gasoline or some other substance is lighted on top of the water. As the fire blazes merrily on, very little rise will be noted in the temperature registered by the thermometer under the water.

The expansion of a rod when heated can plainly be made visible with a few simple bits of apparatus, as shown at the right. One end of the rod is placed in a book, and the other end is allowed to roll over the top of a pencil which has a pointer attached, as shown. A scale on a piece of white paper is placed behind the pointer, so that direct readings of the rod's movements may be made. Any suitable means may be used to supply heat to the length of rod between the book and pencil. As this heat increases, the rod will grow longer and longer and thus roll the pencil, the pointer of which will magnify the movement enough so that it may be plainly seen.



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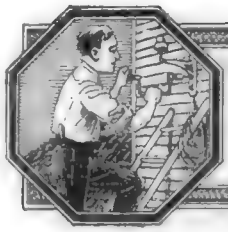


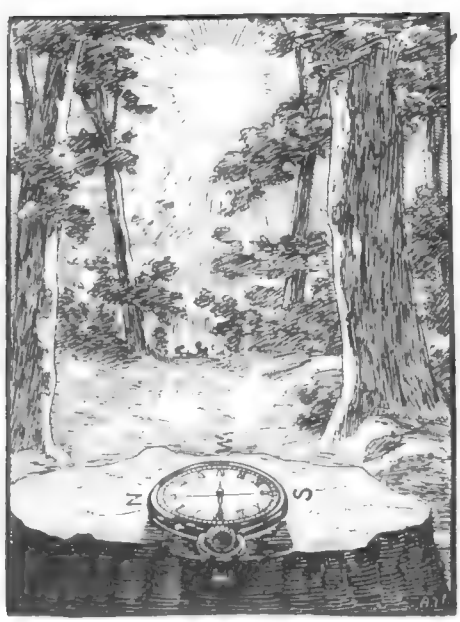
THE CONSTRUCTOR

Steam-Driven Model Boat

A STEAM-DRIVEN model boat that will run for half an hour continuously can readily be built by anyone handy with tools. The hull of the ship is made in sections, being cut from thick flat boards nailed together into the form shown at the left. In order to curve the sides, they should be soaked in hot water until they can readily be bent.

The power plant of this boat may be any one of the many types that can be purchased in toy shops. It can either be mounted in the boat in exactly the same manner as it was made or the engine may be taken apart and distributed along the bottom of the boat so that the balance of the toy will be preserved. A gear on the fly wheel meshes with another on the shaft of the propeller. The latter and the rudder are made of sheet zinc or copper.—Dr. Ernest Bade.

Watch Compass



To use a watch as a compass, place it on a flat surface, point the hour hand at the sun, and south will be found to be half way between the hour hand and the figure 12.
—Dr. A. Neuburger.

Cloud Filter

Often times when taking outdoor scenes with small hand cameras, the resulting photograph disappoints one. Where a standard cloud filter is not available, ordinary sun glasses may be used, holding one of the yellow glasses in front of the lens. The sun glasses should be plain glass or celluloid. Using this idea, length of exposure must be increased.—Charles T. Belden.

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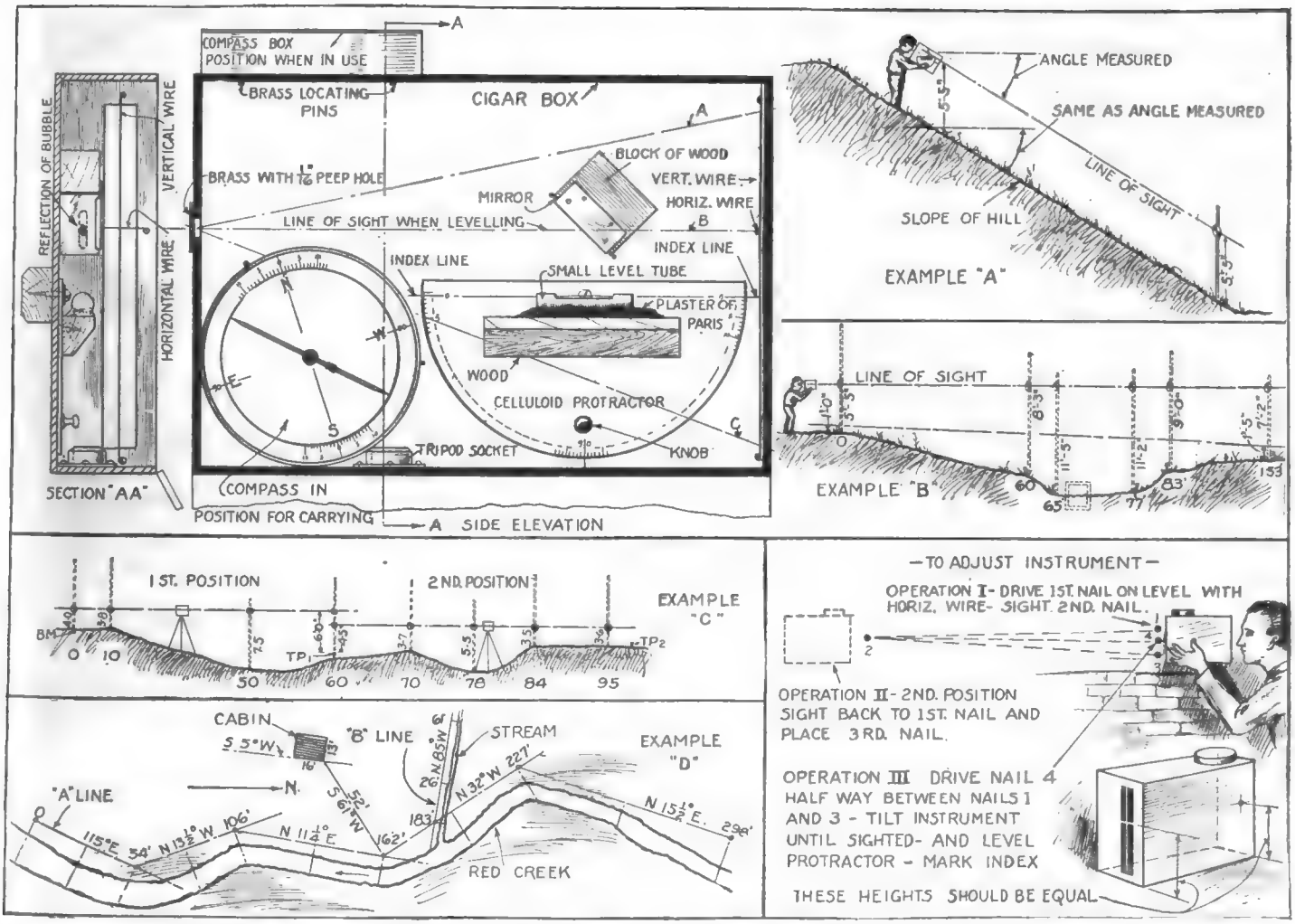
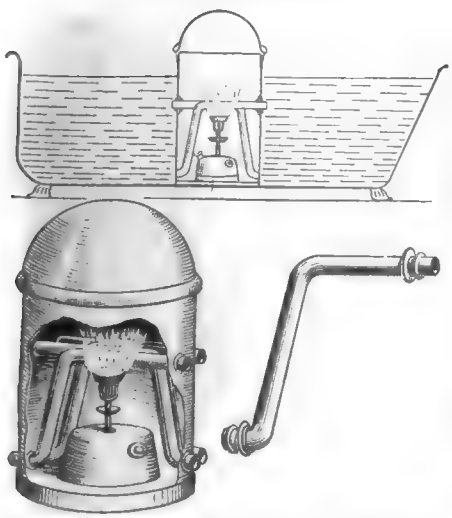
Amateur Surveyor's Transit



For making the above combined transit and level, procure a perfect cigar box, cut the vertical slot in one end as shown. Then drill a 3/8" hole through the opposite end, and cover it with a piece of brass containing a 1/16 inch peep hole. Measure the height carefully of this hole above the box bottom. At exactly the same height, pass the horizontal cross-hair which can be made of a fine wire well across the slot. Place the vertical cross-hair over the slot in the center and exactly parallel to the side of the box. The vertical wire is placed exactly the same distance from the side of the box as the center of the brass peep hole. The compass is placed on the top of the box with the north and south line of its dial passing directly through a line drawn through the vertical cross-hair and the center of the peep hole. Two pins in the compass bottom fitting in holes in the top of the box serve to keep it in place. To the inside of the box a piece of good white drawing paper is glued. A protractor is pinned to a small strip of hardwood, and the level is held to the protractor with plaster of Paris. This level must be exactly parallel to the flat side of the protractor. A screw is run through the exact center of the protractor and fastened to the back of the box. The mirror on the block of wood is placed as shown. The method of using the transit for measuring angles, leveling, and running straight lines is explained in the sketches. Adjustment is also explained.

—H. E. Balfour.

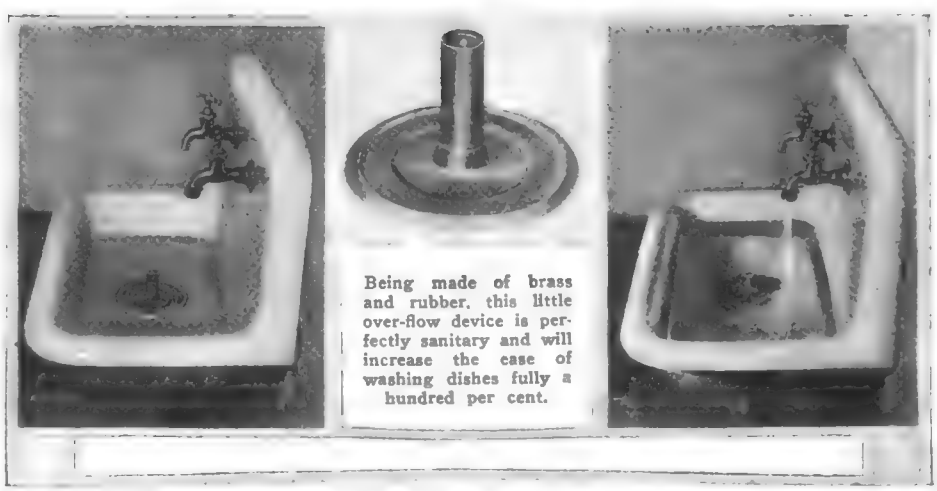
Heater



The device for heating the bath water with a gasoline heater sits into the bath tub. The water circulates through the pipes by convection.

—John P. Stoddart.

Housewife's Sink Kink



Being made of brass and rubber, this little over-flow device is perfectly sanitary and will increase the ease of washing dishes fully a hundred per cent.

For washing dishes with constantly clean water, the little device shown above, recently brought out, will find a hearty reception among the housewives. It is set over the sink outlet and the surface water passes over the top over-flow.

—Author?

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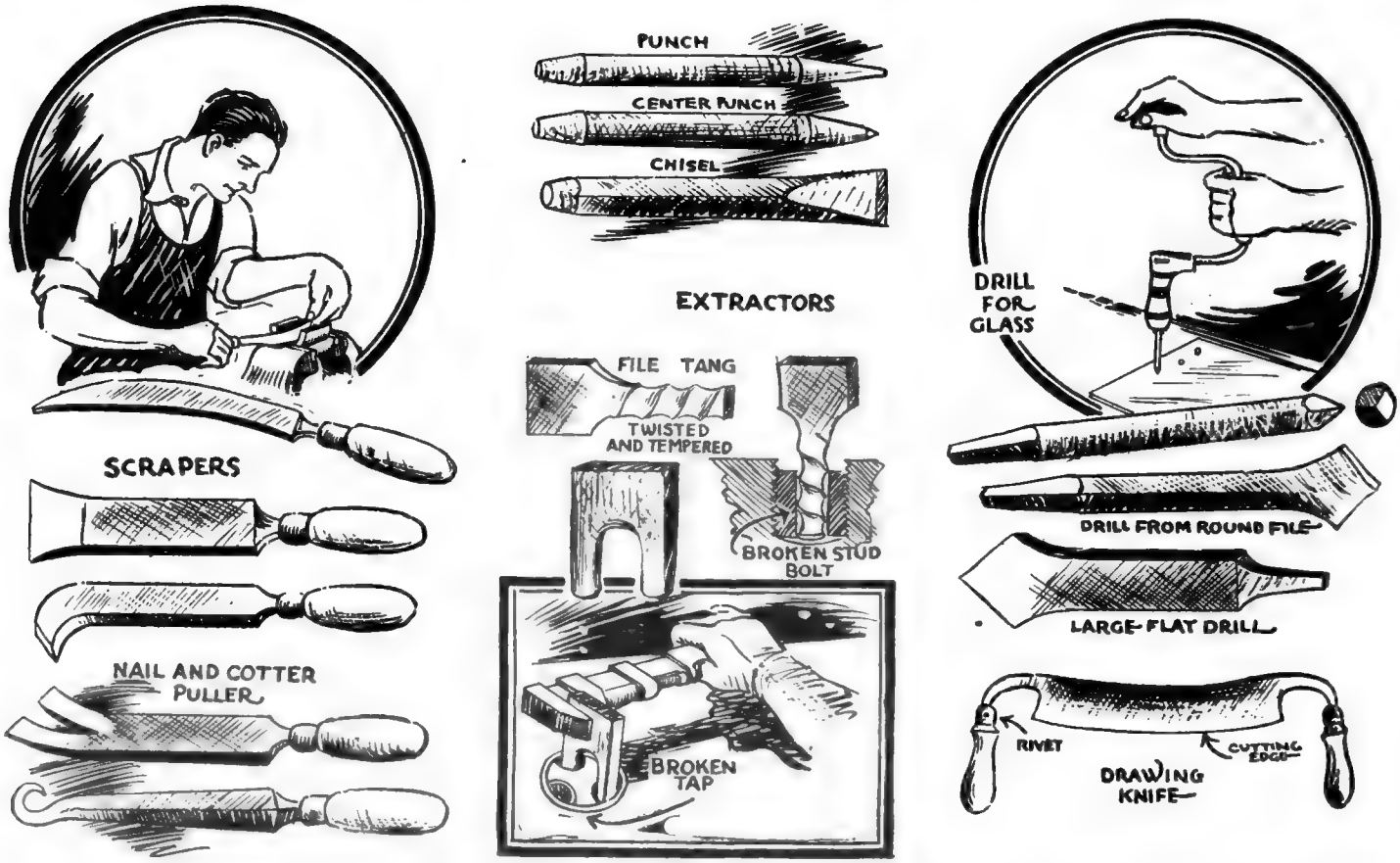
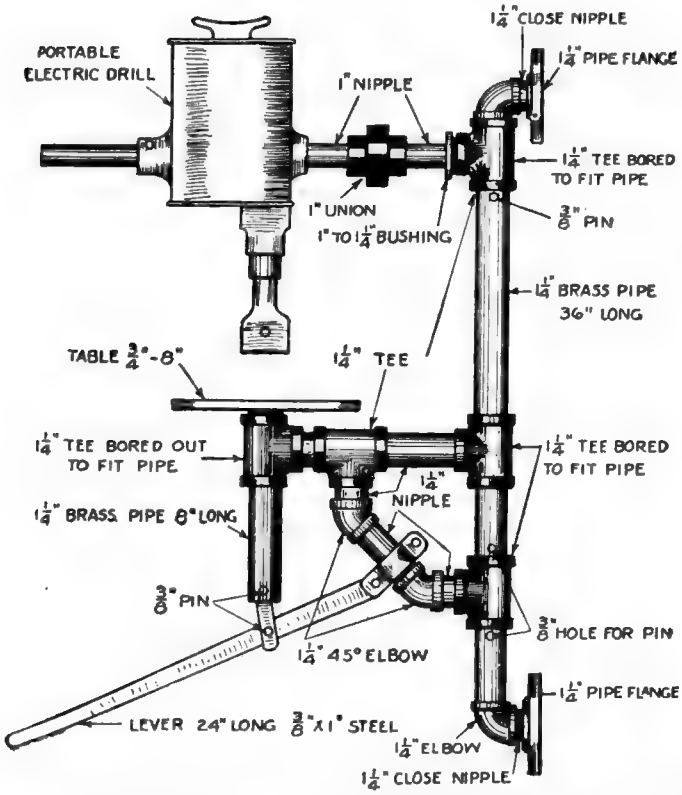
Tool Set from Old Files



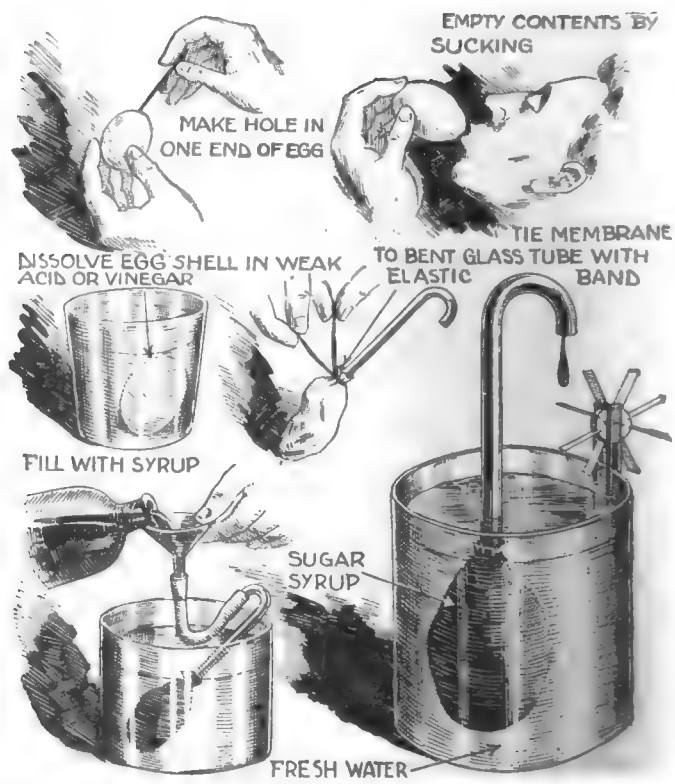
The system of using the metal of old files for the construction of tools has long been known to mechanics. However, a few adaptations are shown in this article which have not before been generally known. In all cases above the temper is drawn from the file, then it is ground into shape and retempered. For all the instruments except the glass drills use a light straw temper; for the latter, use a deep purple.—G. A. Luers

Drill Press



The drill shown above was made of standard 1¼-inch brass pipe fittings equipped with a standard electric drill as the power unit. The work is adjusted by raising the table with the aid of the lever. The pins in the main frame adjusts the height roughly. Brass pipe will be found best. —Harry B. Luessen.

Sugar Motor


EMPTY CONTENTS BY SUCKING
MAKE HOLE IN ONE END OF EGG
TIE MEMBRANE TO BENT GLASS TUBE WITH ELASTIC BAND
DISSOLVE EGG SHELL IN WEAK ACID OR VINEGAR
FILL WITH SYRUP
SUGAR SYRUP
FRESH WATER

Osmosis is responsible for the operation of this motor. A small hole is made in one end of an egg and the contents sucked out. The shell is dissolved away with vinegar or weak acid, and the membrane sack attached to a hooked tube. If the sack is filled with sugar syrup, osmosis will cause the liquid to rise through tube running wheel.—Dr. R. G. Harris.

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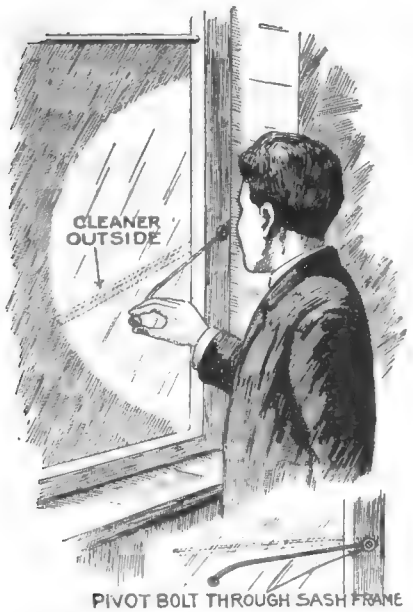
HOW-TO-MAKE-IT

This department will award the following monthly prizes: First prize, $15.00; second prize, $10.00; third prize, $5.00.
The purpose of this department is to stimulate experimenters toward accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department a monthly series of prizes will be awarded. For the best idea submitted a prize of $15.00 is awarded; for the second best idea a $10.00 prize, and for the third best a prize of $5.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

Window Cleaner

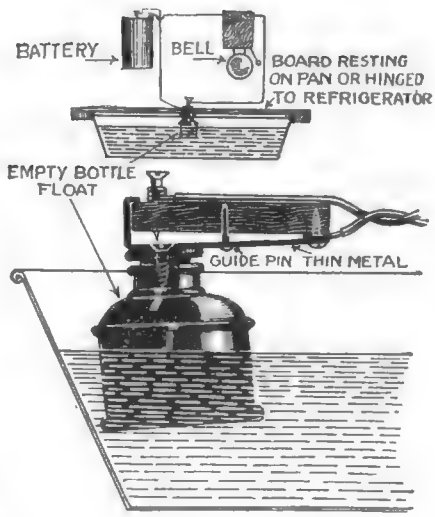
FIRST PRIZE $15.



A discarded automobile windshield cleaner comes in handy when attached to a window frame as shown above. During storms, it permits those inside the house to obtain a clear view outside. —L. B. Robbins.

Overflow Alarm

SECOND PRIZE $10



An alarm to be placed in the drip pan of a refrigerator to sound when the pan is full, may be made as shown above.
—G. W. Beerbewer.

Camera Shield

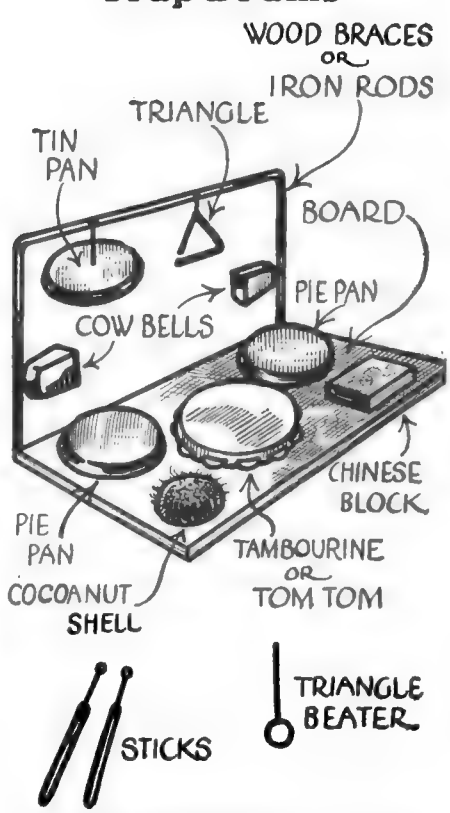
THIRD PRIZE $5

When using large hand cameras, it is often difficult to properly shield the finder with the hand so as to obtain a clear view. This difficulty can be overcome by cutting two shields from sheet tin in the shape shown above and attaching to the camera.
—Andrew Chipka, Sr., Reporter No. 8081.

Burning Steel

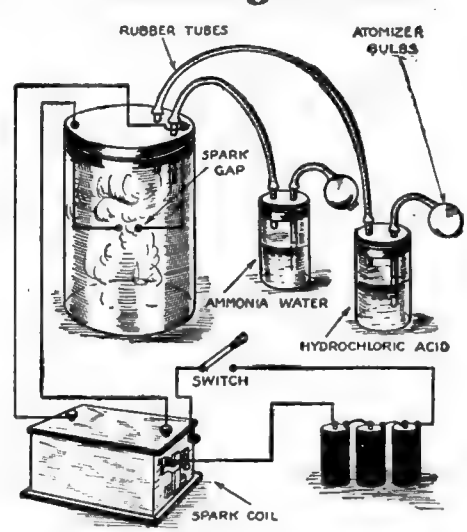
A piece of steel wool, if placed in the flame of a Bunsen burner for a second and removed, will emit bright flashes for about ten seconds. —Arthur A. Blumenfeld.

Trap Drums



The various instruments shown above when mounted as indicated make quite a respectable set of trap drums. Two drum sticks and a triangle beater are also necessary.
—John W. Reed.

Vanishing Smoke



A demonstration of the Cottrell system for precipitation of smoke may be made as shown above. The two gases mingling form smoke. Passing a spark through the smoke precipitates the particles.
—Francis D. Whittemore, B. S.

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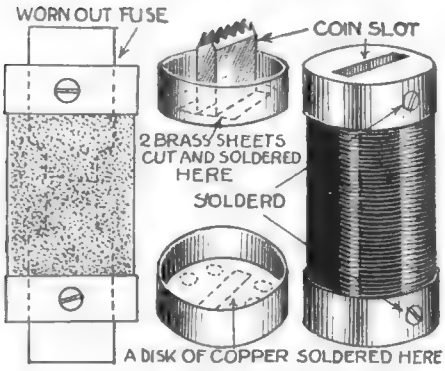
WRINKLES
RECIPES & FORMULAS

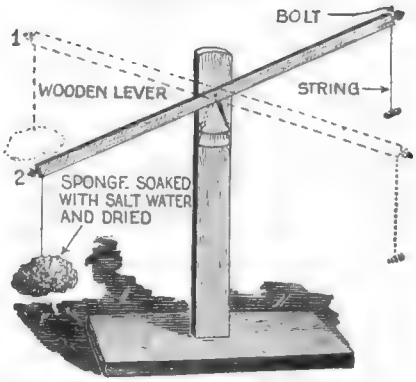
Edited by S. GERNSBACK

Savings Bank



A burned out tubular fuse makes a good savings bank when arranged as shown above. —E. Corral.

Hygrometer

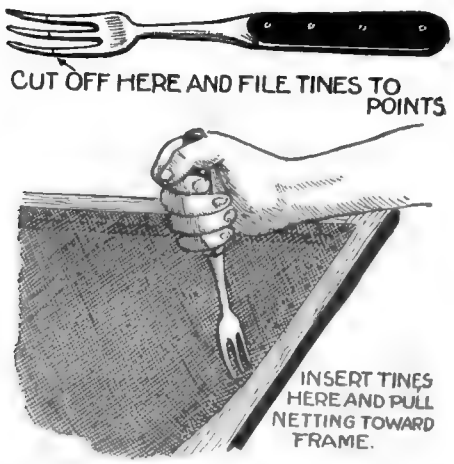


A hygrometer may be made by suspending a sponge as shown. It rises in dry and falls in wet weather. —L. M. Bingaman.

Top Remover

When the screw top on a jar sticks, use the kink that is illustrated above. Pull the string to the right. —Ingolf Kvamme.

Screen Stretcher

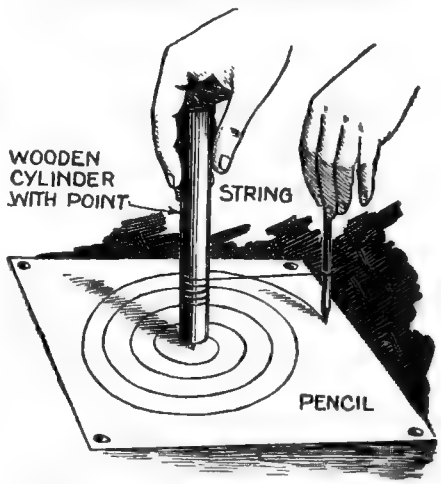


When tacking netting on a frame, use a fork cut as shown above to stretch the material. —Edward Evers.

Can Opener

Another use for a fork is illustrated above. The tines are completely cut off. —Edward Evers.

Simplified Spirals



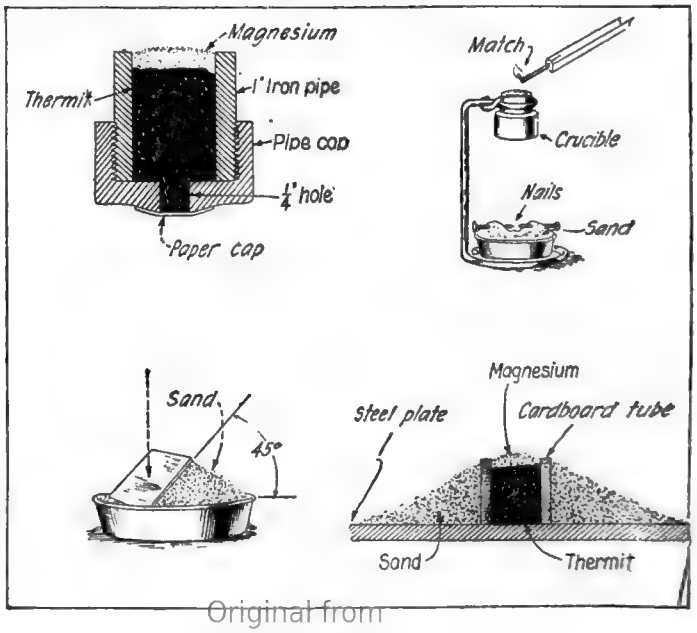
Use this kink for drawing spirals. The string is lengthened or shortened, according to the motion of the pencil. —J. Mursand.

Removing Stains

Left: Indelible ink stains are usually very hard to remove. Soak the stained portion in strong salt water. Then remove and wash the material thoroughly with household ammonia. —Howard C. Kramer.

Thermit Welding Simplified

Right: Thermit is composed of three parts of powdered aluminum, mixed with five parts of iron oxide. It is ignited by means of magnesium. A welding crucible may be made as shown. When welding two nails together, proceed as shown. To melt a hole in sheet iron, mount at a 45° angle. Allow the thermit to fall upon it. For welding a boss to a steel plate, see lower right. The thermit forms the boss. —Charles D. Tenney.



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Readers Forum

A SUGGESTED DEBATE

Editor, *Science and Invention:*

As a reader of your magazine might I be a man so small, with a mind perhaps too narrow to ask for a debate entitled, "The possibilities or rather the impossibilities of perpetual motion, VS., the impossibilities of creation of life."

Your articles on perpetual motion are usually headed "an attempt at the impossible." While an article on "creation of life" was made so flowery as to make the old maid or bachelor hope that in a few years if nature does not produce the mate they desire they may send to Sear's Gomry Ward Roe Buck & Co. and get just what they want.

Believe me to be an interested reader of your excellent magazine.

G. V. Timblin,
Indiana, Pa.

(Whether creation of cells that live, reproduce and die has anything to do with the creation of man, or not, is a question which we do not care to enter upon. Nevertheless, Mr. Mazur in the article "Artificial Creation of Life" appearing in the July issue of this publication, page 261, gave complete instructions on how to duplicate the effects he obtained, so that anyone unskilled in the art could duplicate the result. Not only did Mr. Mazur tell how to produce the effects but he also produced them.

All the perpetual motion enthusiasts we have met tell how to obtain power from the machines of their brain, but do not produce the effect themselves.

This leads us to the inevitable conclusion that the designers of perpetual motion machines do not know what they are designing, otherwise they would have developed eons ago a machine that will work by gravity alone.—Editor.)

GRAVITATION LACKING

Editor, *Science and Invention:*

At last with the opening of the Readers' Forum, I can ask a question that has been bothering me for some time. Why is it that when Dr. Hackensaw and Pep are flying around so calmly in the story, "Dr. Hackensaw's Trip to the Moon," there are articles on the table and cot which, though not fastened, do not move? In such case why would not a tea pot take to the air as did Dr. Hackensaw and Pep? Of course, if you say it wouldn't, I'll believe it, but why wouldn't it?

When articles are rejected, do you always return them to the writer? May I say that Ben-Zyls paper ladder should have won first prize—in the joke contest? I do not wish to offend anyone by this statement.

James W. Rogers,
Jackson, Tenn.

(The reason that the tea pot does not leave the table when Dr. Hackensaw's car is flying to the moon is because of the fact that the gravitational attraction at the particular spot described in the story is practically nil, consequently, the result is that the tea pot and the table attract each other in direct proportion to their mass and inversely as the square of the distance between them. The tea pot resting on the table in the first place will not tend to draw the table away from its position in the car, there being no distance between the two objects. The attraction of the table for the tea pot is considerably greater than that of the tea pot for the table because the mass of the table is greater than that of the tea pot. The table on the other hand is attracted by the car following the same rules and consequently remains practically in its original position. On the other hand Dr. Hackensaw and Pep float around in the car, which position they attain by the use of muscular effort. You will recall that they practically pushed themselves upwardly into the air and then found that they were floating around.

Rejected articles are returned whenever stamps are enclosed with the manuscripts. Very often, the manuscripts are of considerable value to the writer and the writer neglects to enclose the necessary transportation charges for the return of his papers. In these cases the manuscripts are returned by us. Those articles that are considered of no practical value and which we believe have no value to the writer are thrown into the waste paper basket. If, therefore, you want to be assured that your manuscripts will be returned you should enclose stamps to defray mailing charges.

With regard to Ben-Zyl's Paper Ladder, we would suggest that said individual received no prize for his contribution. As an experiment, the article is interesting. A prominent lecturer used this paper ladder for years in his demonstrations of paper magic. There is no practical use for such a ladder.

The editor would further advise that it is not necessary to apologize for any statements that you may make. The Readers' Forum is for our readers and we will air their views and comment upon the same, should we deem comments advisable.—Editor.)

THE SHOWER OF FISH

Editor, *Science and Invention:*

When J. A. T.'s fingers were badly burned through the handling of radium at the Memorial Hospital, he was advised to go on a long vacation, far away from those benevolent-malignant radium emanations if he desired to preserve his fingers and hands.

Alaska, and the North in general, held no charm, for bitter memories remained of cold, and snow, and perpetual ice, so it was decided to prospect our Southern Neighbors, searching for Carnotite, Pitchblende or other radium active mineral. Carnotite Ore, valued at times because of the radium content at hundreds of thousands of dollars per ton, like gold, is found according to the old prospectors' theory—"where you find it."

While in Spanish Honduras, during one of our periodical visits to "town"—or should a half dozen adobe huts with a score of Indians be called a metropolis,—we learned of a phenomenon said to occur yearly on the outskirts of the capitol city of the State of Yore, Honduras.

The natives swore that between the thirteenth and eighteenth of each June a heavy storm comes up and when the violence of the storm has subsided the people emerge from their homes and gather up fish which have descended from the clouds.

Being so close we decided to investigate the phenomenon, for besides being of great scientific interest the biblical societies would probably welcome our return to the states with wreaths of glory—for if it rained fish why not Biblical loaves of bread. So over steep mountains covered with moss bearded verdure, slashing trails through fetid mats of jungle, passing old towns peopled with Indians, with here and there an ancient Spanish Church smouldering to ruin, we eventually arrived in the city of Yore, which is situated in a great broad valley.

In Yore, we quartered with the mayor, an affable man who scouted the legend but admitted that the year previous he had seen some tiny sardine like fish fall upon the ground after a great storm.

In the morning we walked out to the ground known as "El Pantano" where the fish were supposed to fall. There were no lakes, streams or volcanoes nearby and it appeared as though it would be a strange phenomenon. The tiny mountain streams were not very prolific with fish, while the mayor said those which he saw were unlike any he had ever seen in the local streams.

The twentieth of June dawned, several days past the date that the wonderful "Iluvia del pescades" was supposed to fall and we decided to continue our search for ores. The story of the "rain of fish" is well known to tropical travelers, to the men of the fruit plantations, prospectors and timber men and it is the younger of them that scoff at the mention of the rain of fish, but the older men, who have fought their way through the jungle and swamp, over rugged mountains, shake their heads and refuse to commit themselves.

Another legend of Honduras, in the Department of Gracias, near the frontier of Salvador, is that of a spring of blood, which when tested with tincture of iron will clot. Various attempts have been made to bring a sample of the liquid out, but upon arriving in the lowlands the substance seems to ferment and burst the containers. The story also goes that if left the substance will separate into white and red corpuscles.

L. K. Wright,
Astoria, L. I.

(Although the rain of fish is a possibility the legend of the stream of blood is highly improbable. There are many substances in water which will produce a marked color change when a drop or two of iron chloride is added to the water. A small quantity of tannin in water produces with iron chloride a jet-black solution which to the superstitiously inclined may appear to be a clot. The bursting of containers can be due only to fermentation. This does not seem very plausible and sounds more like fiction. The precipitation of red and white corpuscles from water is absurd. There is a possibility that the blood of some animal may be washed away in the water on some occasions, but that would not be a constant factor and hence the story must be listened to with more than a passing doubt in mind.—Editor.)

SPEED BOAT

Editor, *Science and Invention:*

In the October issue of Science and Invention there is an article on a Simple and Efficient Motor Launch. Can you tell me the size of this boat?

C. B. Towers,
New York City, N. Y.

(Let us read what Mr. P. G. Howes, Assistant Curator of the Bruce Museum at Greenwich, Connecticut, has to write:

"The boat, which by the way I built myself, is eighteen feet over all by four feet six beam. In the tests that I gave it, it carried three passengers sitting on the decks and cabin and towed a fourteen foot skiff containing four more. All of these were full grown people.

"The entire cabin inside is taken up with engine, bilge-pump, etc.

"I should add that since writing the article I have had to cut down the power of the engine so that the boat makes about ten miles an hour, as the higher speed started to tear things up. The boat is now over the experimental stage, and I use it every day. It causes endless interest and there are often many cars stopped along by my house to watch proceedings.

"I have also found the addition of paddle covers necessary, as the wheels throw considerable water."

This gives you the information you requested. —Editor.)

SPIRIT SEEKER

Editor, *Science and Invention:*

I saw an article in the June 16th, 1923, "Pathfinder" entitled, "Proof of Spirits Will Win $6,000." To settle this baffling controversy whether spirits exist I wrote to them and they referred me to you. For five years at different times I have heard and seen over two hundred spirits; in other words, people that have passed from the Earth to the Life Beyond. In the last two years people from the other world have bothered me a great deal; more so than they did before that. Some seem very glad to see me and they express it that way. Some talked of music and of school and others of interests here below. They seem to think that the time passes very slowly over there. Some spoke of things that had happened that we both know of. Their appearance was the same as when I last saw them and they talked as naturally. Some of them told me what spirit was. They said that spirit was mind and *that* only. They can think, talk and remember and that is all. They say that mind or spirit is very insufficient and they find it very monotonous over there. They all appear in their physical form that they had here on earth because mere mind was so inadequate to express themselves if they do not. I do not know but do not think it ever possible for anyone to take a psychic photograph of a spirit for spirit is mind. One can only photograph material subjects. Spirit or mind has no substance. Thence people that have passed from earth to the Life Beyond or spirit life, cannot make themselves physical or material because they have no substance. Mind is not

(*Continued on page* 940)

SCIENCE AND INVENTION desires to hear from its readers. It solicits comments of general scientific interest, and will appreciate opinions on science subjects. The arguments pro and con will be aired on this page. This magazine also relishes criticisms, and will present them in both palatable and unpalatable forms. So if you have anything to say, this is the place to say it in. Please limit your letters to 500 words and address your letters to Editor—The Readers Forum, c/o Science and Invention Magazine, 53 Park Place, New York City.

The Experimenter

has come back! If you are one of the one hundred thousand readers of the old Electrical Experimenter, you will no doubt be glad to hear that the Experimenter is coming back BIGGER AND BETTER THAN EVER. Practical Electrics has been changed into an entirely new kind of magazine entitled

The Experimenter

In this magazine which has been greatly enlarged in point of contents, illustrations and circulation, you will find the following new departments:

Experimental Radio
Experimental Chemistry

There is an entirely new treatment of radio containing experiments only. *90% of the magazine contains pure experiments* written by the foremost authorities in their respective fields, also a monthly editorial by the writer.

A fine roto-gravure section is now added to brighten up the magazine. *If you want experiments, this is your magazine.*

Be sure to reserve a copy from your news-dealer before the issue is sold out. THE EXPERIMENTER will be on sale at all newsstands beginning December 20th, 1924.

Hugo Gernsback
Editor

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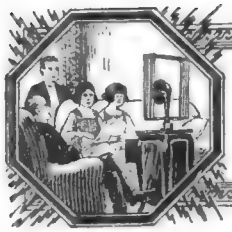
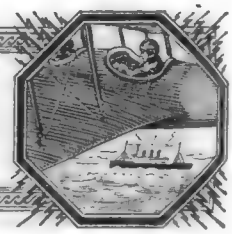
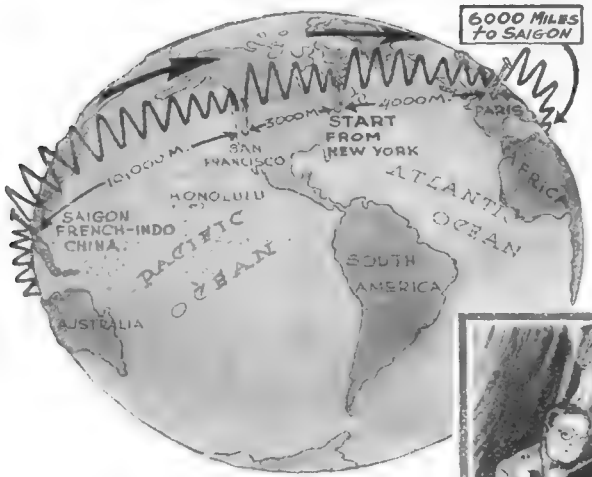


RADIO



"Round the World Relay"

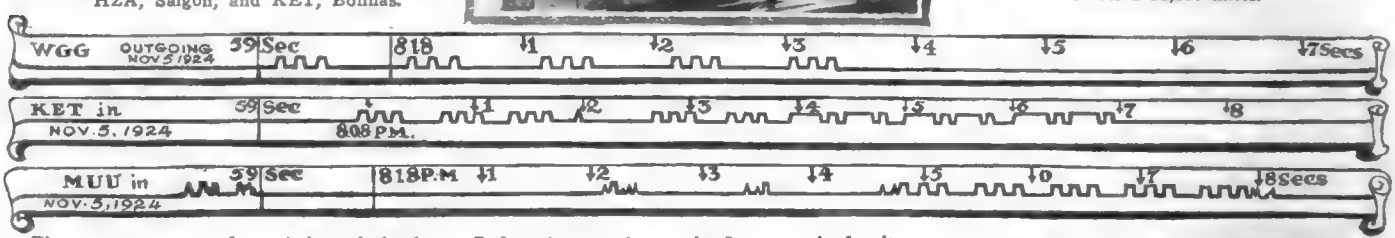
By LEON L. ADELMAN



At the Radio Show held recently at the Grand Central Palace, New York City, two signals were started, one racing around the world eastward in the form of the letter C, and the other westward as S.

At a given signal, the attendant in charge threw a switch which started both signals simultaneously. To the eastward, the letter C sped from New York to Paris, from Paris to Saigon, thence to San Francisco, and finally was retransmitted back to New York. This signal covered a total distance of 23,000 miles and was handled by four very powerful radio stations, respectively, WQK, Rocky Point; UFU, Saint Assise; HZA, Saigon, and KET, Bolinas.

At the same instant that the letter C was started eastward, the letter S sped on its journey westward, starting from New York, to San Francisco, to Honolulu, to Java, thence to London and finally back to New York. Starting from WGG at Tuckerton, it was swiftly retransmitted by KET, KIE at Kahuku, then by PKX at Malabar, on to MUU at Carnarvon and finally back to its starting point. Because it was handled by five stations, the letter S traveled 28,800 miles.



The message eastward consisting of the letter C five times took exactly five seconds for its complete journey, whereas the letter S was completed in six. Tape No. 1 shows signal S leaving New York via Tuckerton, WGG. Signal C left Rocky Point, WQK, simultaneously. Tape No. 2 shows the arrival of the letter C from San Francisco, and immediately preceding it is the record of San Francisco's retransmission of signal S, westward to Honolulu. Tape No. 3 shows the arrival of the westward signal S from London, all tapes being recorded at New York.

After more than two weeks of careful planning and experiments, the engineers of the Radio Corp. of America in conjunction with Compagnie Radio-France; Compagnie Generale de Telegraphie Sans Fil; Administration of Posts and Telegraphs, Dutch East Indies; Marconi's Wireless Telegraph Co., Ltd., and Transradio AG fuer draht'osen Uebersee Verkehr, were able to accomplish this great feat. Left: Main recording room.

All the signals were received at the R. C. A.'s receiving station at River Head, L. I., from which the signals were pased in over land wires to the main office on Broad Street, New York City. Here they were recorded on tape moving at a given rate and calibrated in seconds. The engineer in charge is shown here [illegible] the record breaking relay.

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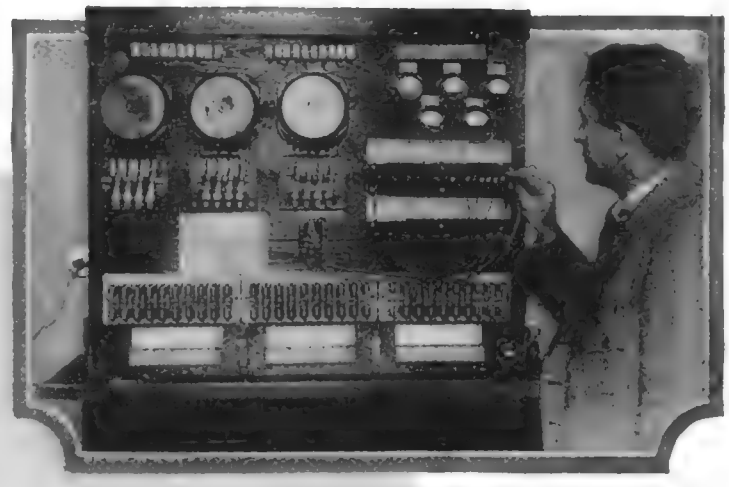
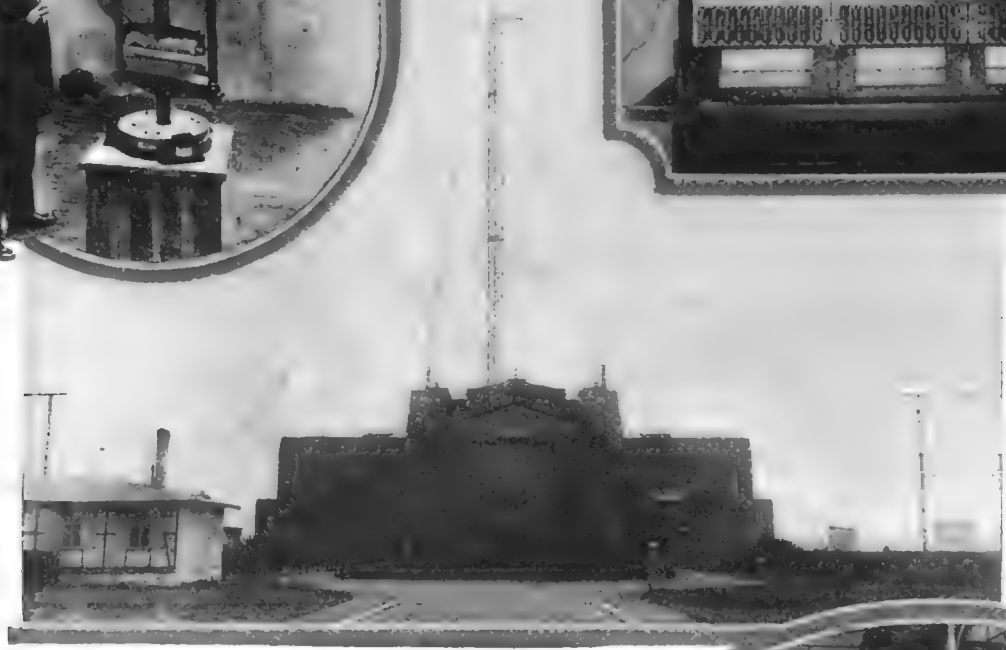
Nauen Radio Station

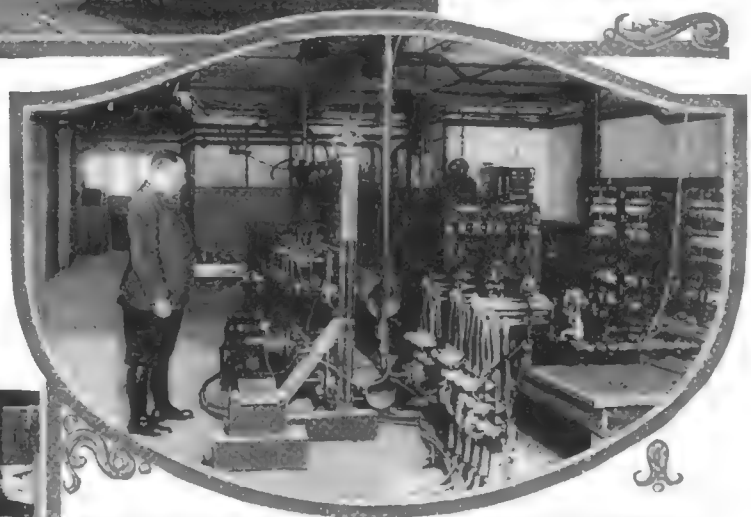
Left: The gigantic indoor loop aerial shown receives from the United States trans-Atlantic stations.



Above: One of the switchboards in the transmitting room of the large trans-Atlantic radio station at Nauen, Germany. The transmitter has a power of 300 kilowatts and operates on a wave-length of approximately 20,000 meters.



Left: A partial view of the large antenna system employed at Nauen, Germany. Some of the large buildings necessary to house the apparatus used in this station are also shown. This station is in regular communication with the United States.



Right: A portion of the transmitting apparatus of station POZ. The power used in this station is so great and the apparatus so bulky, that it is necessary to have a separate room for practically each particular portion of the transmitting set. This station is used by the German government for naval and other governmental communications.

Nauen is now making some very interesting and important tests on 85 meter and lower—wave-lengths.

Above: The final receiving room where messages from all over the world are recorded at Nauen, Germany. Most of the receiving is done on a tape and then decoded. The messages are then either retransmitted, mailed, or delivered by messenger.

Right: Another view of part of the receiving control room as well as a section of the transmitting controls. The particular transmitting apparatus shown is for relay work to outlying districts.

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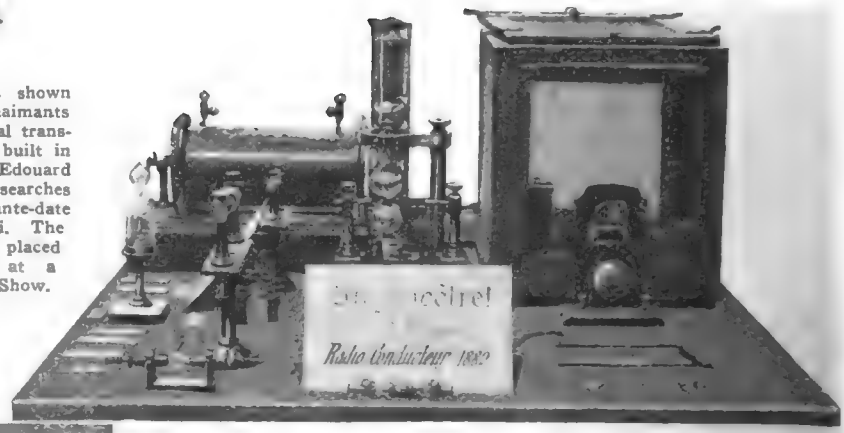
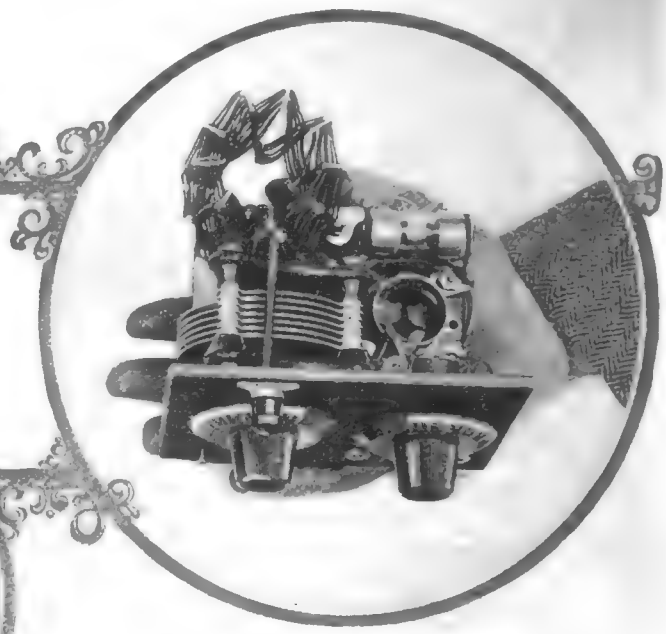
Radio Pictorial

At the right is shown what French claimants say is the original transmitter. It was built in 1889 by Dr. Edouard Branly, whose researches are said to ante-date those of Marconi. The apparatus was placed on exhibition at a French Radio Show.

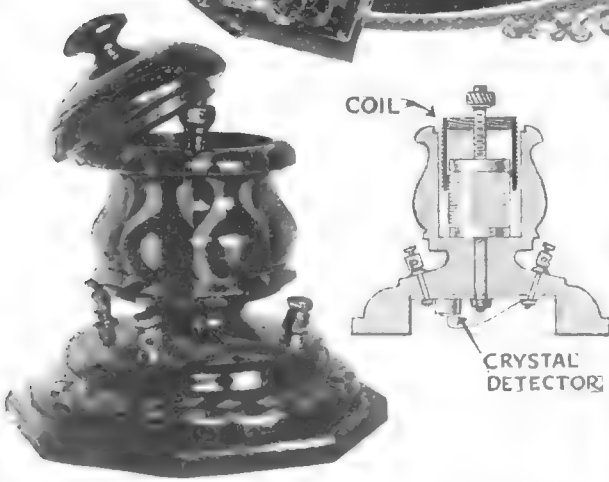


The prize contest at the New York "Radio World's Fair" brought forth many marvels in radio construction. One of the most interesting of the entries is that shown below. Following the regular lines of radio set construction Fred C. Mathews of North Bergen, N. J., built one of the world's smallest regenerators. Low loss apparatus was used throughout.

The miniature farm shown above is not a plaything but a complete radio receiving set. This is another of the entries in the Radio World's Fair home built receiver contest. The animals control the rheostats. The loud speaker is seen in well at extreme right of photo.



E. T. Flewelling, famous radio designer, has brought forth another radio set. It is a six tube outfit and it proved at a demonstration held recently to be a wonder for DX reception.



One of the prettiest as well as one of the most novel designs in radio receivers which has come to our notice recently is that shown above. Made in the form of a small urn, it is turned from two kinds of wood. The crystal detector is in the base.

The purveyor of entertainment through the loud speaker shown above was careful of getting his license, for it certainly makes a lot of noise. It is installed a-top a high Berlin building, in which the firm manufacturing the unit has its quarters. It is an excellent advertisement.

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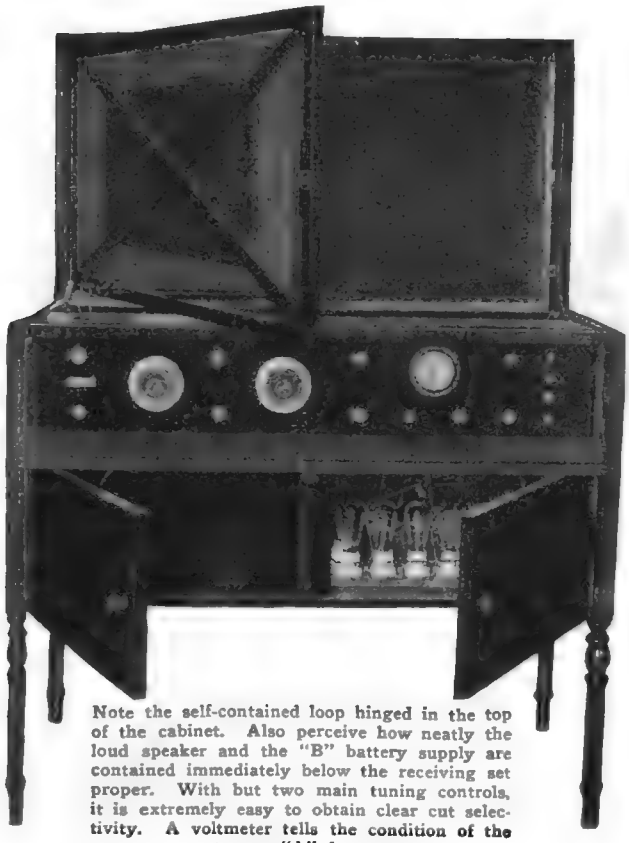
"An Ultra Super"

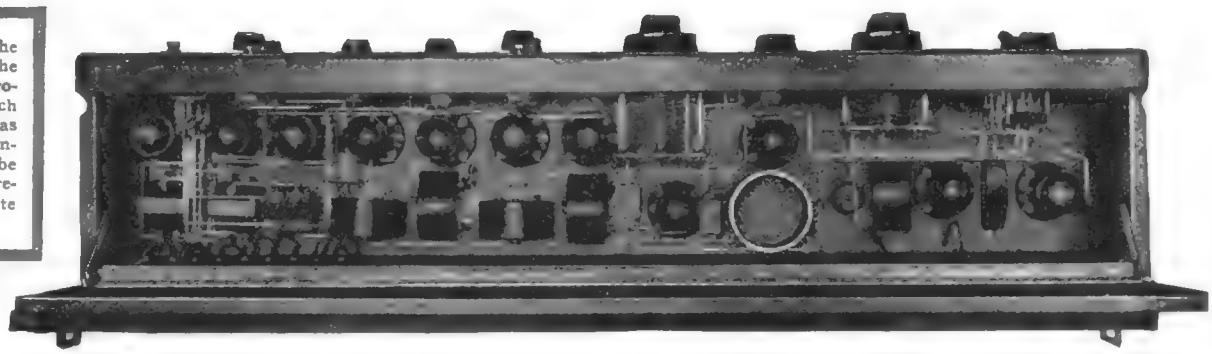
By R. W. DeMOTT

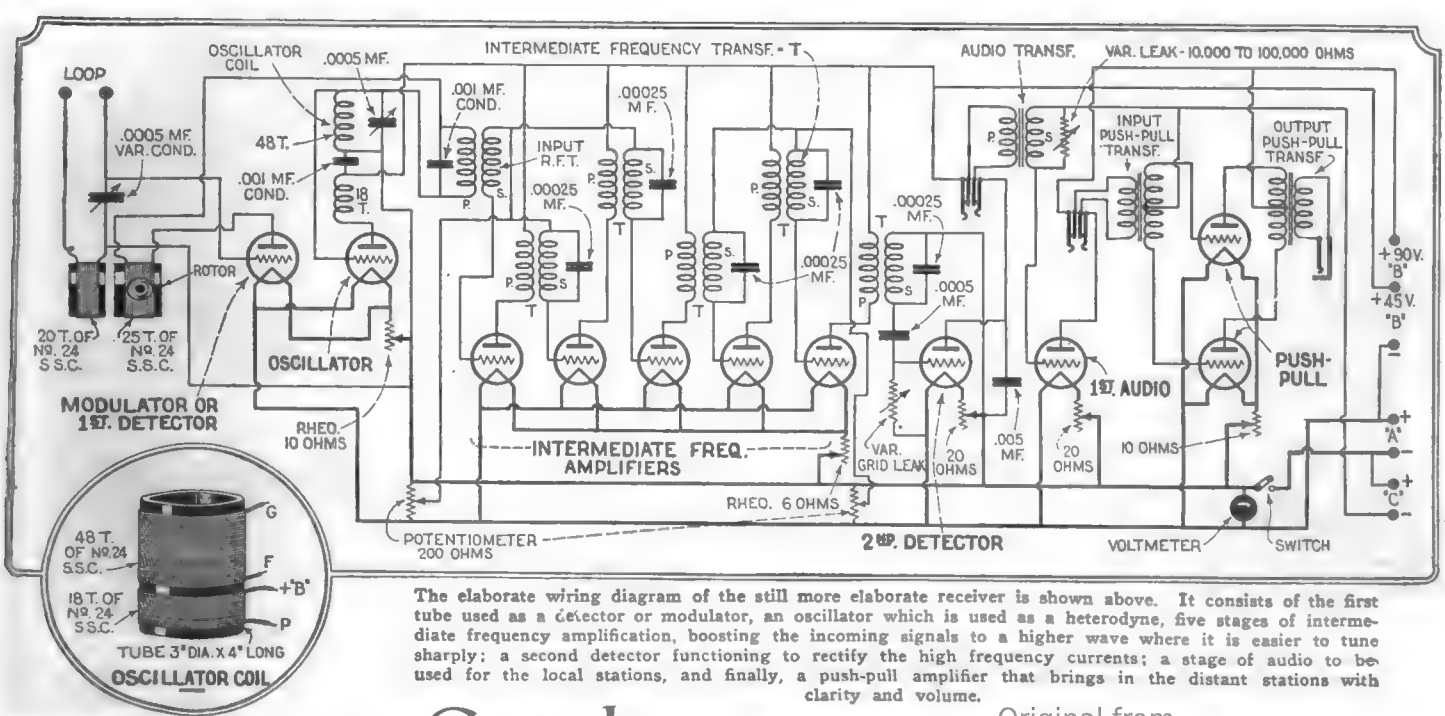


Note the self-contained loop hinged in the top of the cabinet. Also perceive how neatly the loud speaker and the "B" battery supply are contained immediately below the receiving set proper. With but two main tuning controls, it is extremely easy to obtain clear cut selectivity. A voltmeter tells the condition of the storage "A" battery.

For the more advanced radio technician, the ultra sensitive super-heterodyne modified as described below, will furnish the best to be obtained. Built in compact form, all parts being contained within a beautiful mahogany cabinet, the pleasing appearance and the unexcelled results accruing from the minute care taken in the construction of this extraordinary receiving set have more than fulfilled all expectations. For the average layman, it may be somewhat difficult to assemble, but by due and careful consideration of the execution of the necessary details the result of one's labor will be a magnificent creation of which he may justly be proud.

The interior of the cabinet containing the modified super-heterodyne shows how much painstaking work was involved in its construction. As will be readily seen, the receiver has a separate cabinet.





The elaborate wiring diagram of the still more elaborate receiver is shown above. It consists of the first tube used as a detector or modulator, an oscillator which is used as a heterodyne, five stages of intermediate frequency amplification, boosting the incoming signals to a higher wave where it is easier to tune sharply; a second detector functioning to rectify the high frequency currents; a stage of audio to be used for the local stations, and finally, a push-pull amplifier that brings in the distant stations with clarity and volume.

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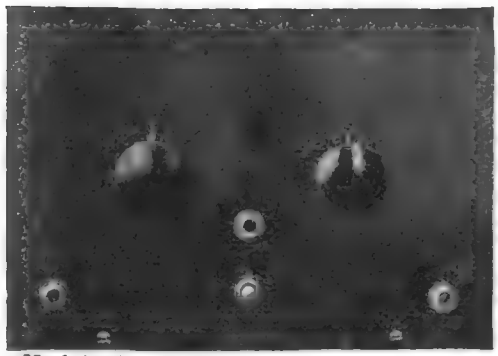
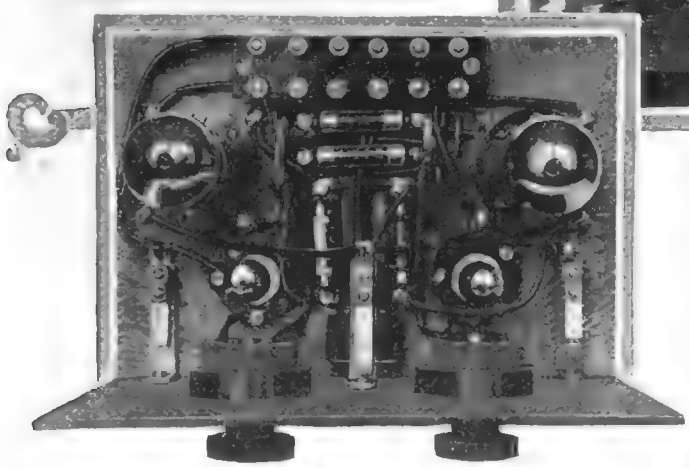
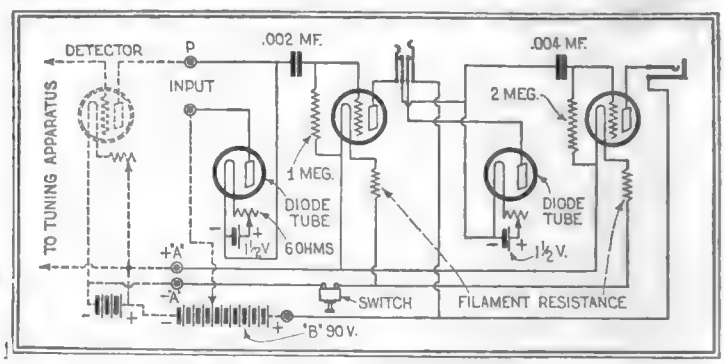
A New Distortionless Amplifier



Much has been said in favor of resistance coupled amplifiers. Here is one that surpasses them all. It employs the well known diode tubes.



The above photo shows a view of the two step audio frequency amplifier employing the new method of coupling. In the upper right-hand corner is shown a group of New York newspaper men listening attentively to Mr. J. W. Marshall, a Philadelphian, the inventor of the system. Tests show no distortion whatsoever, both on local and distant stations, and with no apparent diminution in volume.

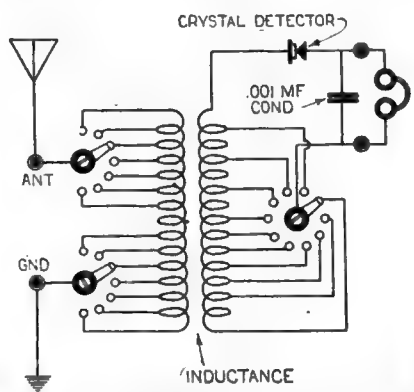


The diode tubes employ a single dry cell to light their filaments. Not only does the tube function as a plain resistance coupled amplifier, but its use allows of a lower "B" battery voltage being employed. The above diagram shows how the amplifier may be connected.

Novel Miniature Crystal Set

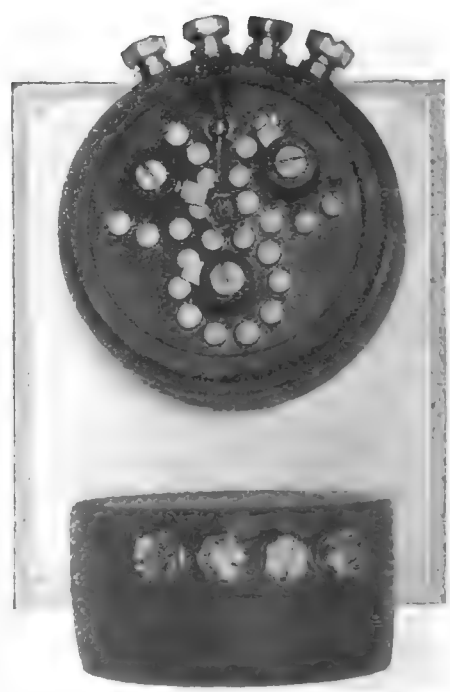
By W. J. RITTALL

The owner is shown with his complete crystal set which is smaller than the ordinary earphone and fits easily within the palm of his hand. The set is unique in that it has three very small switch levers which tune both primary and secondary circuits.



The primary consists of 300 feet of No. 38 S. C. C. wire, tapped at every 20 feet and is wound in a compact coil, 2 inches in diameter. The secondary contains 400 feet of the same wire, tapped at every 40 feet.

Here is a real honest-to-goodness crystal set that gives splendid results when used in conjunction with a single wire aerial, 100 to 200 feet long. An ordinary pill box is used, though a circular bakelite "panel" contains the necessary contacts, switch levers, and crystal detector. Stations several hundred miles distant have been heard, though it must be remembered that a sensitive crystal must be employed. A fixed condenser is incorporated.



Note the neat and careful workmanship. Four handy binding posts afford easy connections for the aerial, ground and phones.

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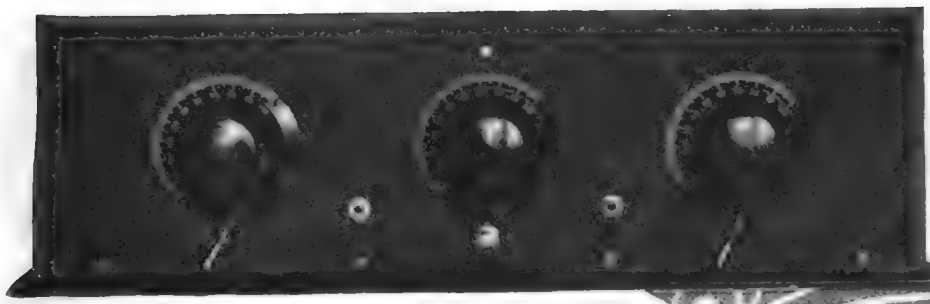
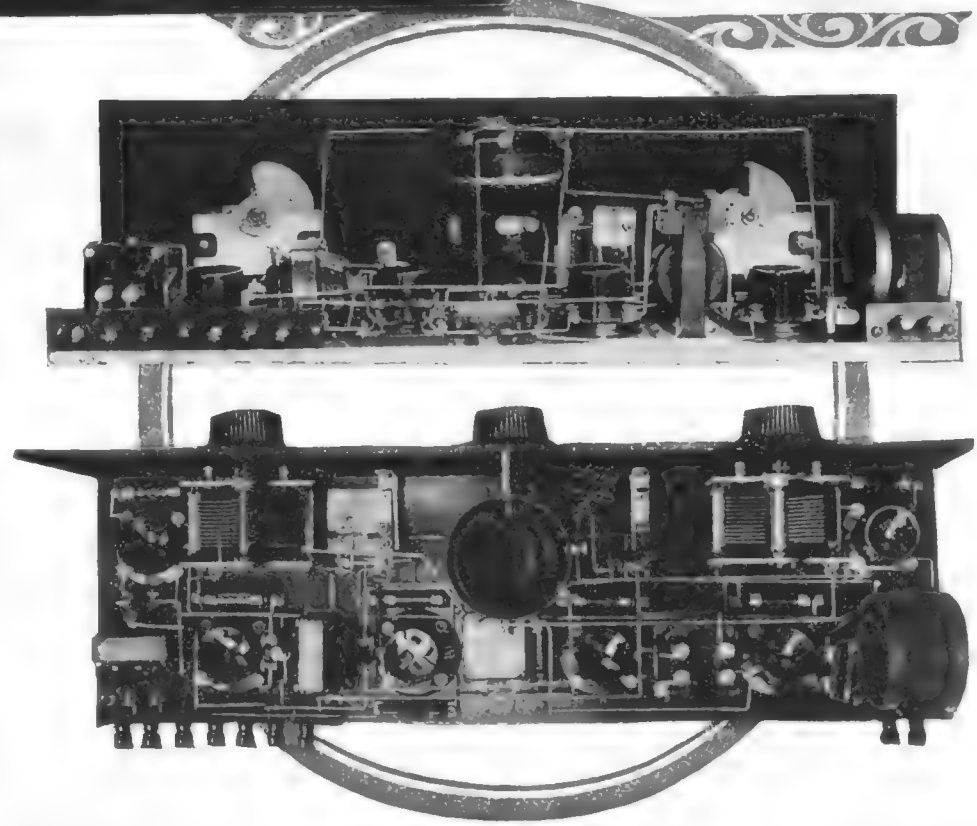
A Remarkable Six Tube Receiver

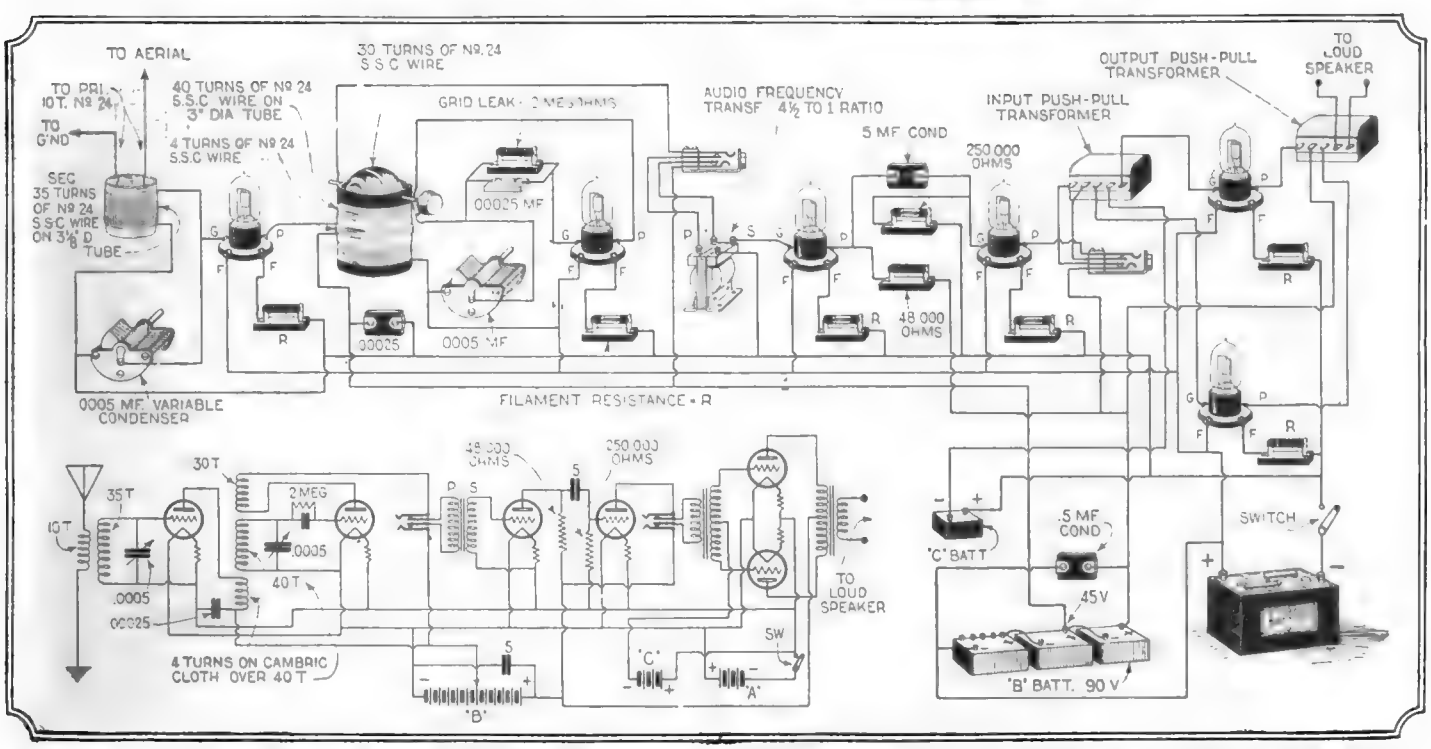
By GRANDON LYONS



With a view towards getting ease of control, selectivity, quality of reproduction and good volume, this receiver was built and fulfills every condition. Its one stage of radio frequency amplification acts as a distance getter and radiation preventer. The detector to which is added regeneration, in conjunction with one stage of transformer and resistance coupled audio frequency amplification gives unexcelled clarity. Again, the well balanced push-pull amplifier affords sufficient volume to amplify without distortion.

THE foremost consideration in the construction of a multi-tube set is perhaps that of ease of control. After this primary consideration, should come clarity of reproduction, while, thirdly, distance getting ability. Exhaustive tests made with this set have proved that stations but five meters apart can be heard without the semblance of interference. With but two main tuning controls, and an optional control for regeneration, the set is practically well adapted for ease in tuning. Augmenting this feature is its pleasing appearance. Covering a wave-length range of from 200 to 580 meters, stations within a 1,500-mile radius are received on the loud speaker, nightly. One outstanding feature is the elimination entirely of all filament rheostats. In their stead are used filament resistances which allow sufficient current to operate the 201A tubes, which are employed. The primary of the radio frequency transformer which can be an ordinary neutroformer coil, contains 10 turns of wire, thus making it of the shock excited type. This type of tuning makes selectivity a much simpler task, for as it were, the antenna circuit is semi-aperiodic and therefore, non-partial to frequencies of its fundamental wave-length. It is advisable to use a single wire antenna about 100 feet long. Note the well proportioned layout.





Following the above circuit diagram through, we find that it incorporates every essential for the production of superior results. The variocoupler employed uses no smaller than No. 24 wire since unnecessary resistance with its deleterious effect would be manifest. In the plate circuit or on the tickler, a smaller wire can be used, since it aids in controlling regeneration and minimizes oscillations.

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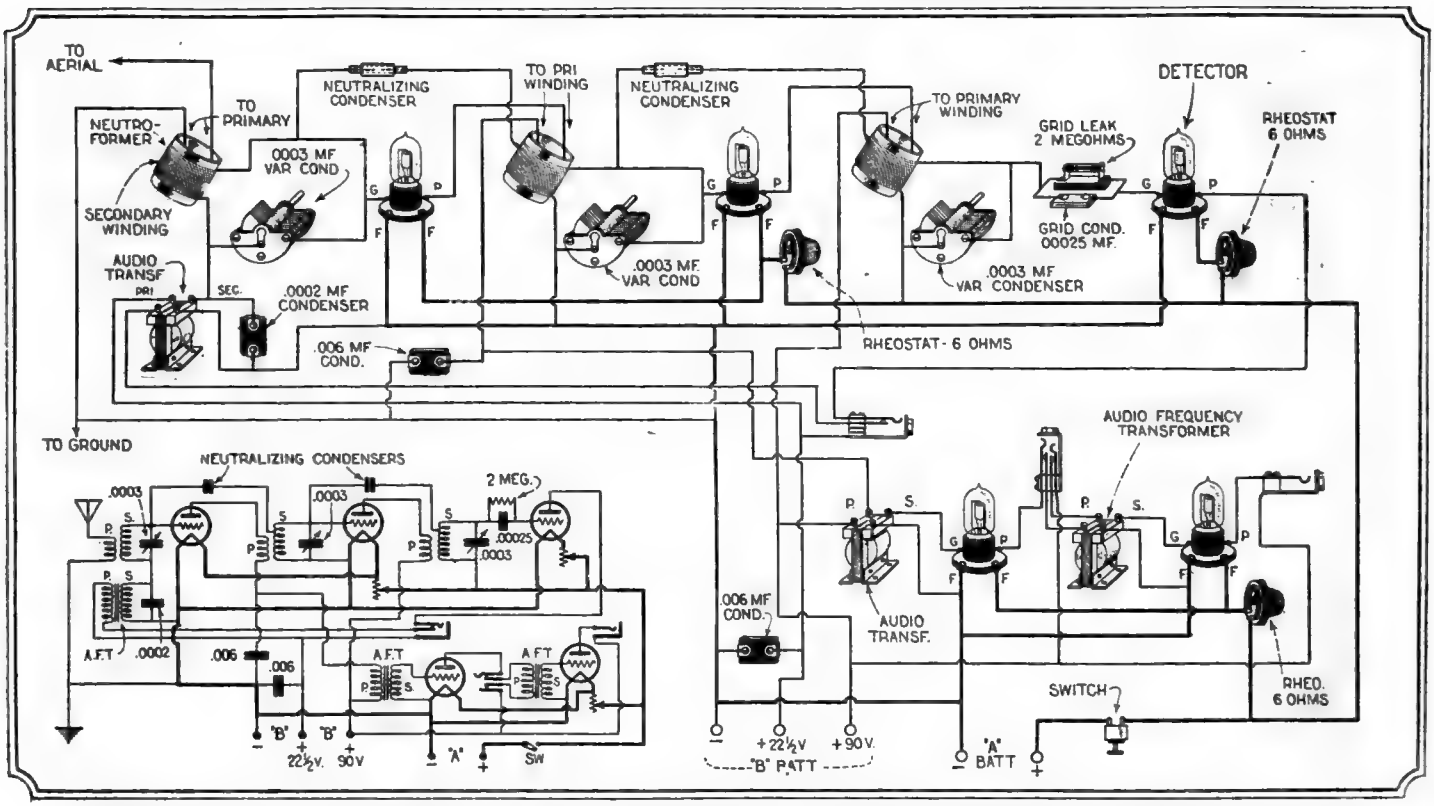
Radio Oracle

In this Department we publish questions and answers which we feel are of interest to the novice and amateur. Letters addressed to this Department cannot be answered free. A charge of 25c. is made for all questions where a personal answer is desired.



Those who have a four tube reflexed neutrodyne will find that an added stage of audio frequency amplification will vastly improve the volume on distant stations. The diagram shows explicitly how this can best be done. It is best, perhaps, to rewire the set completely for superior results.

REFLEX NEUTRODYNE

(323) James J. Ashton, Pensacola, Fla., asks:

Q. 1. Can you give me a diagram for adding one stage of audio frequency amplification to my four tube reflex Neutrodyne receiver?

A. 1. The above diagram gives in full detail the exact wiring that is employed to add one additional stage of audio frequency. It is best to rewire your set completely, so the diagram shows the circuit as one complete set. The only additional parts you will need will be a double circuit and single circuit jack, a four to one audio frequency transformer, a six ohm rheostat and a standard socket.

THERMAL AMMETER

(324) Stuart Thompson, Jersey City, N. J., asks:

Q. 1. What is the basic principle of operation of the thermal ammeter and how does it differ from the ordinary types of ammeters?

A. 1. The formula $P = RI^2$ represents the basic principle of the thermal ammeter where P is the power consumed as heat in the instrument. The deflection of the pointer of the instrument depends directly upon the heating effect of the current. In order that the relationship of P to I, the current, should remain constant so that a given deflection will always correspond to the same amount of current, it is necessary that R, the resistance of the instrument should not change with the frequency. To accomplish this, the conductor must have a very small cross-section and the working element of a thermal ammeter must be a fine wire or a very thin strip of metal. An error of not more than 1% is allowed in instruments used in most ordinary radio work over any range of frequency employed. Thus for the ordinary instrument, a copper wire of 0.08 milliammeters in diameter is used. As can readily be seen, a single wire of this size can carry at best, only a few amperes, because larger currents would overheat the wire and perhaps burn it up. Contrary to general opinion, the length of the wire is not important. It is only long enough so that the current distribution within it is not appreciably altered by the terminals to which it is connected. Such instruments when properly constructed may be calibrated with direct current or low frequency alternating current and the calibration assumed to be correct at high frequency. Of course, if possible, it is always best to calibrate the ammeter by comparison with some recognized standard at the frequencies at which it will be used. At the high frequencies, it must be remembered that errors in the readings are liable to occur. Thus, not all the current traverses the wire element, but some of it is shunted through the dielectric or the material of which the case of the meter is made. However, the hot wire ammeter of the ordinary design will give fairly accurate readings. For measuring radio currents of about 0.003 to 3 amperes it must be borne in mind that it is the cheapest meter obtainable.

INTERFERENCE BY RADIATION

(325) William Shaw, Meadville, Pa., asks:

Q. 1. Kindly publish information as to which of the following sets cause interference by radiation.

*Autoplex
Neutrodyne
Ultradyne
*Single Circuit Regenerative
*Three Circuit Regenerative
*Cockaday Four Circuit
*Reinartz
Reflex
*Ultra Audion
Radio Frequency Tuned Receiver

Note—Those marked with an asterisk, *, radiate.

The only way to know best when a receiver is radiating is by actual test for it is not always radiating when a squeal is heard in the phones. This can best be done by arranging with a neighbor to listen in. In any case, the listener must have his set oscillating.

CORRECT PHRASEOLOGY

(326) Richard Coleman, Sioux City, Iowa, wants to know:

Q. 1. Will you kindly decide for us which is the correct phrasing for a 201A, UV-199 or other receiving tube?

A. 1. While audions are often called tubes, lamps, valves, electron relays and bulbs, the proper phraseology would be to call them by their correct trademarked name such as UV-201A, UV-199, C-300, etc.

WANTED!!! RADIO ARTICLES

WE want descriptions of new radio ideas which you have worked out in practice. Take photographs of the important parts and make pencil or pen and ink sketches of the hook-ups or mechanical details, et cetera. We are particularly desirous of obtaining new hook-ups and descriptions of single tube sets, reflex and other types which have proven satisfactory. We like articles on new single tube receptors. We will pay good prices for your ideas. —Editor.

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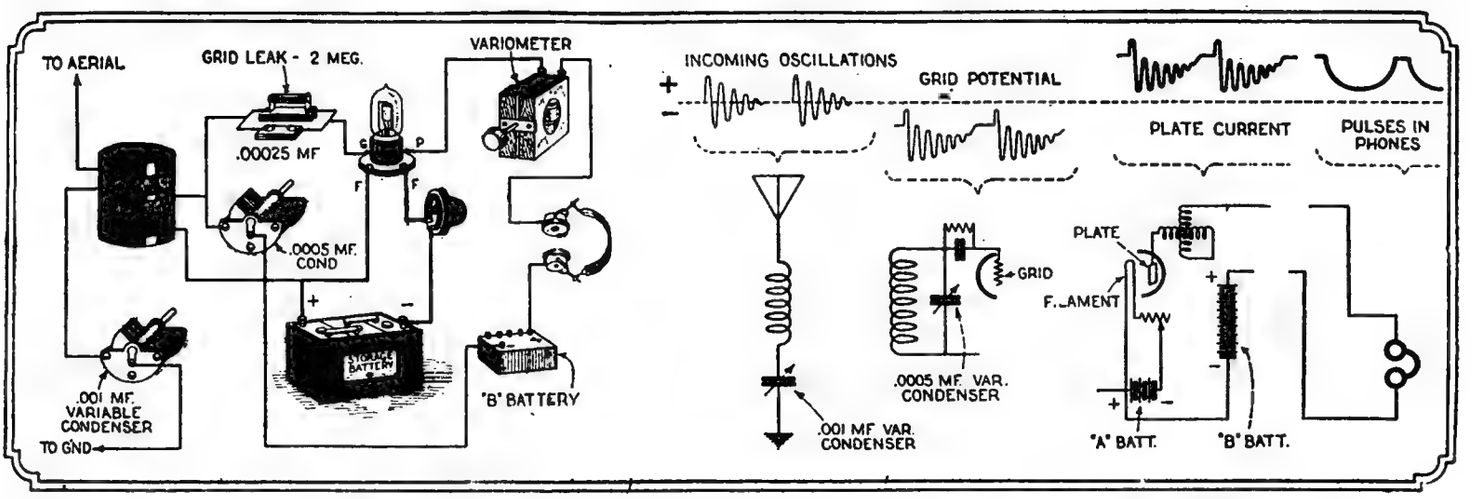

Just what happens in the different parts of a simple regenerative circuit is depicted here. Memorize the diagrams. They will help you in solving and understanding more complicated hook-ups.

FUNDAMENTALS

(327) George Davis, West New York, New Jersey, asks:

Q. 1. Kindly show and explain the various wave forms and transformations in a simple regenerative circuit?

A. 1. In the antenna circuit (Fig. 1), the incoming oscillations are absorbed to a maximum degree if the circuit is in resonance with the wave. From the primary inductance, the energy is transferred to the secondary circuit (Fig. 3), in which it assumes the wave form as shown in the accompanying sketch. This is due to the rectifying action of the detector. As the current in the plate circuit is always direct and varies at radio frequency, its wave form is shown depicted in No. 3. Due to the responsive action of the diaphragm in the phones, what is known as the actual value of the current fluctuations in the plate circuit are reproduced, assuming the variations as shown in 4.

PHASE ANGLE

(328) George F. Dowell, Chatham, N. J., asks:

Q. 1. Kindly explain in full what is meant by phase angle?

A. 1. Ordinarily in taking up the study of electro-motive force and current, the element of time is not always taken into account. It is only done so when we speak of electricity in terms of energy, kilowatt hour, horse power hour, etc. In direct current, phase angle does not exist, since the current and voltage generated rise and fall together. In alternating current circuits, both the current and the voltage are alternating, that is, each rises from zero to a maximum value in one direction and back to zero and maximum in the other direction. These two alternations are what is known as a complete cycle. When the current and voltage start from zero and reach a maximum at the same instant and return to zero and reach a maximum in the opposite direction at the same time, they are said to be in phase. Whatever their positive or negative values may be, whether one is larger than the other, the voltage must reach its maximum or minimum at the same time the current does, if both are in phase.

However, if the voltage reaches a maximum before the current does, the voltage is said to be leading the current and the current is said to be lagging. Usually, it is spoken of as either lead or lag of the current referred to the voltage where circuits comprise inductance or capacity. Even in our receiving sets such conditions exist and there is always a phase difference between the current and voltage. It is customary to measure this difference in degrees. Thus, when the phase angle difference is known to be 90°, the current is either leading or lagging the voltage; when one is maximum, the other is zero. The radian, an arc whose length is equal to that of the radius of its circle (5 F. 296°) is often used.

Where a circuit comprises resistance only, the voltage and current are always in phase. If it were possible to eliminate the resistance from a circuit leaving inductance only, the current would lag the voltage by 90°; also, if the resistance were removed from a circuit leaving capacity only, the current would lead the voltage by 90°. However, since resistance is always present in any circuit, the 90° phase angle is never obtained. Whether the current lags or leads, the predominant value of inductance or capacity determines this.

The action of a current affected by inductance may be compared to inertia in mechanics. When near the end of a single alternation, with the resultant decrease in current value, the inductive effect tends to oppose this diminution and continue the flow. This effect can be readily observed by breaking the circuit composed of a large inductance in series with an alternating current source. Promiscuous arcing across the key contacts will also show the great tendency of the current to continue its flow. The same applies when the current is reaching its maximum value. It is choked down or opposed by the inductance and at any one instant the momentary value of the current is less than the momentary value of the voltage divided by the resistance. Thus either capacity or inductance tends to smooth out an alternating current and the difference between the instantaneous values of current and the voltage is what is known as the phase angle between them.

What Is It?
$20.00 Prize

By HUGO GERNSBACK

HERE is a puzzle that may well tax your ingenuity. SCIENCE & INVENTION offers $20.00 for the best solution of the puzzle. This puzzle will be known as the *"Five Sense Mystery"*. The subject under consideration is an inanimate thing—meaning that it is not living.

You can taste it;
you can smell it;
you can hear it;
you can see it and,
you can feel it,—

in other words you use all of your five senses. Yet, and most important, *you must never touch the particular thing.*

Although this may seem impossible, it not only can be readily done, but you probably have done it many times yourself.

The particular thing is found in almost every household. It is *not*, for instance the wind, the ocean, etc.

There will be one prize of $20.00 for the best answer to the correct solution. The prize will go to the person who not only gives the correct solution, but gives the solution in the shortest amount of space in the simplest language.

Should two contestants submit the same answer, the same prize will go to both. This contest closes Feb. 15, 1925.

Address all replies to Editor, *Five Sense Mystery*, c/o this Publication, 53 Park Place, N. Y. C.

DeForest and Fessenden—Read Their Biographies

In the October issue of *Radio News*, there started a biography of Dr. Lee DeForest, inventor of the Audion. This biography will run for 12 months in *Radio News* and we hope all SCIENCE AND INVENTION readers will read this important work by the famous inventor. In the January number Prof. Reginald A Fessenden's biography will start.

INTERESTING ARTICLES TO APPEAR IN THE JANUARY ISSUE OF RADIO NEWS

The Radio on the ZR-3. By Captain H. C. Flemming.

A Zero Carrier-Wave Broadcast Transmitter, By G. H. Dacy.

Super-Power Broadcasting. By Louis Frank.

Beginning: The Inventions of Reginald A. Fessenden

The Discovery of the Oscillating Crystal. By Dr. Greenleaf W. Pickard.

Modern Radio Storage Batteries, By James M. Skinner

Analyzing High Frequency Resistance of Single Layer Coils, By Sylvan Harris.

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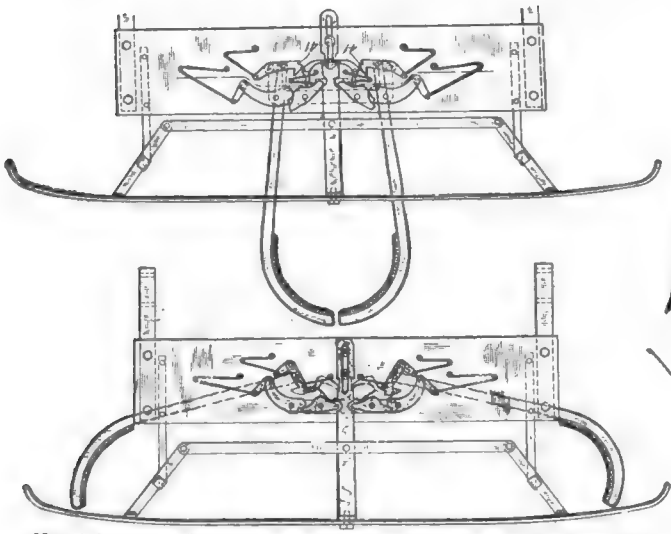
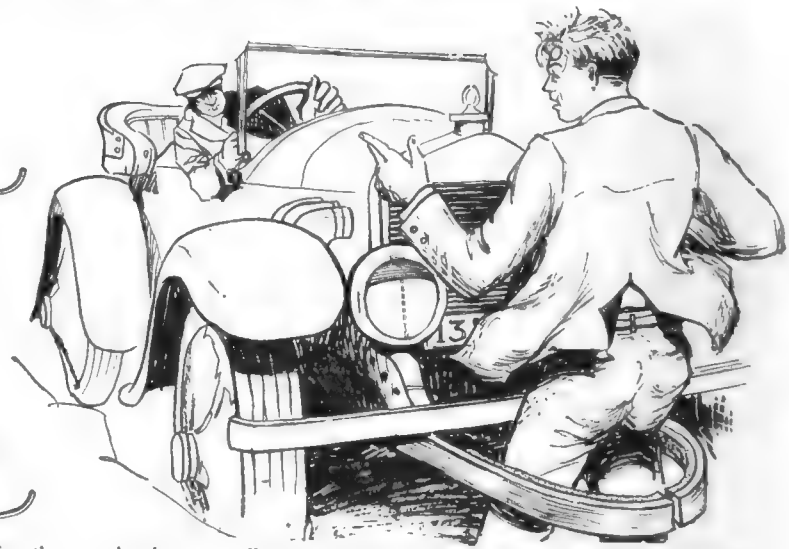
LATEST PATENTS

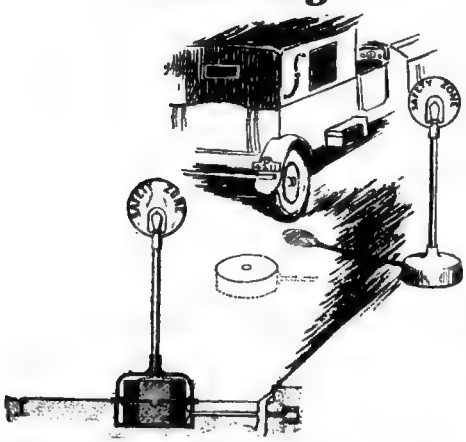
Captivating Automobile Bumper





No. 1,509,991. Issued to S. Advent. This latest attachment for the front of an automobile is designed to prevent a person from being thrown aside when struck by a car. We wonder what will happen when a car, going into a small parking space strikes the spare tire of the car in front of it and the curved arms are released. The operating mechanism of the bumper is shown at the left above.

Traffic Sign



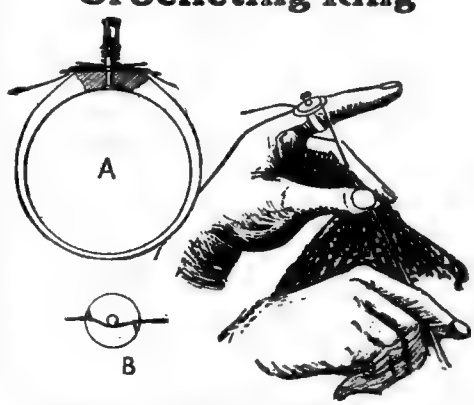
The traffic sign illustrated above can be removed from its position without necessitating the removal of any wires whatsoever. The current is supplied to the light by means of a transformer. The primary coil is set into the street at a point where the light is to be located. The secondary coil is in the base of the sign.

WANTED

ARTICLES pertaining to automobiles such as handy kinks, roadside repairs and anything of interest to the man who drives a car. $50.00 in prizes every month are offered by MOTOR CAMPER AND TOURIST for such articles. Get a copy at your newsstand and see what is wanted. If your newsdealer cannot supply you send for free sample copy to:

MOTOR CAMPER & TOURIST
53 Park Place,
New York City.

Crocheting Ring

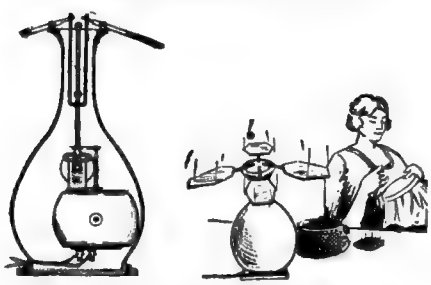


This latest patent should be of interest to all the ladies. It pertains to a ring that is of great assistance when crocheting. A cross-section of the ring is shown at A. The crocheting thread is drawn through one of the disks as shown at B and is held taut, by means of the friction between the two disks caused by the action of the small spiral spring upon the upper disk.

Mirror Holder

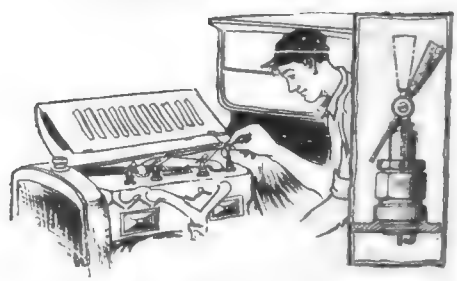
No. 1,509,746. Issued to George A. Zeidler. And now, gentlemen, when we get up in the morning and proceed with our shaving, we can gird on our armor as illustrated above. This mirror is designed to be held in the desired position as shown. Here is a caution, however. Do not do your deep-breathing exercises while using this attachment.

Ornamental Fan



Instead of the usual circular type of fan, an ingenious inventor has patented the one shown above. An electric motor actuates a set of arms which are in turn fastened to other arms, on the ends of which are located flat surfaces as shown. These oscillate up and down, producing a breeze.

Engine Tell-Tale



No. 1,510,601. Issued to John H. Mount. This spark plug attachment allows anyone testing an engine to determine which cylinders are firing without recourse to a screw driver for short-circuiting the plugs. Merely pushing the handle to an upright position and listening to the sound of the motor tells whether or not that cylinder is firing.

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Scientific Humor

THE SCIENTIFIC MIND

They led him out of his cell early that morning and down the short corridor to the little room. It was the first time he had ever been in the death chamber. He looked about and noted its appurtenances, the small barred window and finally the chair. As they strapped him in it he turned curiously to one of the guards.

"Does the prison generate its own electricity?" he asked.—*Louis Ginsburg.*

WU'D A PIG GO ALONG WITH IT?

CHORUS GIRL: "I bought a Super - Heterodyne receiving set for a song."

DISGUSTED RADIO FAN: "That's nothing. I bought mine for a squeal."—*N. Compton.*

WE'D STEP ON THE GAS

CHEMISTRY TEACHER: "This gas is deadly poison, what steps would you take if it should escape?"

CHARLTON: "Long ones."—*Roger M. Johnston,* Reporter No. 13294.

THE LIE DETECTOR

"A Familiar Instrument."

DINTY: "Do you believe that there is really something which can invariably tell when a man is lying?"

JIGGS: "I know it."

DINTY: "Ah! Perhaps you have seen one of the instruments?"

JIGGS: "Seen one? I married one!"—*Alexander Lozouski.*

AND A RAT IN THE HAIR

SMITH: "That woman reminds me of one of Doctor Hackensaw's creations."

JONES: "How's that?"

SMITH: "Well she has a deer face, bear knees, snakey eyes and pigeon toes."—*J. Ilivich.*

JOHN, BRING THE OTHER SIFTER

PROF.: "How long is a short circuit?"

STUDENT: "As long as it lasts."—*Harry J. Walters.*

SHOULD BE INDUCTED

PROF. OF CHEM. (eyeing empty seat): "Where's Henry?"

STUDENT: "Gone."

PROF: "Where did he go?"

STUDENT: "Straight up."—*Richard Barrett.*

THEY ARE BOTH DISCUSSED

1ST NUT: "How does a psychic differ from a radio fan?"

2ND NUT: "I give up."

1ST NUT: "The psychic gazes at a crystal and the radio fan cusses at it."—*Charles Carter.*

FRIGID SILENCE REIGNED

PROF. TO ZOOLOGY CLASS: "And where do animals grow the most fat, around the North Pole or the equator?"

STUDENT: "Around the equator, of course."—*Robert L. Fuller.*

First Prize $3.00

HARD ON THE HEN

PAT: "So you have a new invention. What is it?"

MIKE: "It is a revolving nest. When the hen lays an egg, the nest turns and the egg falls on some straw under the floor. When the hen turns around and sees no egg, she will think she has not laid one, and will go right back and lay another."—*Chas. Grill.*

COMING DOWN TO EARTH

FRED: "She appears planetary to me."

ED: "Has she the figure of Venus?"

FRED: "No, but she has Mars on her face."—*A. Daansen.*

WE receive daily from one to two hundred contributions to this department. Of these only one or two are available. We desire to publish only scientific humor and all contributions should be original if possible. Do not copy jokes from old books or other publications as they have little or no chance here. By scientific humor we mean only such jokes as contain something of a scientific nature. Note our prize winners. Write each joke on a separate sheet and sign your name and address to it. Write only on one side of sheet. We cannot return unaccepted jokes. Please do not enclose return postage.

All jokes published here are paid for at the rate of one dollar each, beside the first prize of three dollars for the best jokes submitted each month. In the event that two people send in the same joke so as to tie for the prize, then the sum of three dollars in cash will be paid to each one.

HE GOT THE GATE THEN!

Three boys were discussing radio distances they had reached.

1—"I got Chicago last night."

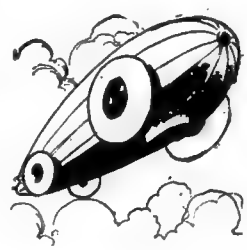
2—"Well, I stuck my set outdoors and got Chile."

3—That's nothing, I put my set in the sink and got Grease."—*Everett Shepard.*

THE ANNOUNCER WAS NO CAKE EATER

WIFE: "How do you like my cake? I got the recipe over the radio."

HUSBAND (trying to bite into the cake): "That recipe must have been broadcast through the Rocky Mountains."—*Ralph Womer.*



HE TIRES OUR READERS

This month's strychnine sundae goes to the new mechanic who thought balloon tires were first designed for the Shenandoah. —*C. E. Weinland.*

DISTANCE DOESN'T LEND ENCHANTMENT THIS TIME

The most recent law discovered in physics is:

The amount of talking done in a classroom is directly proportional to the distance from the teacher.—*G. Fashena.*

ONE EXACT ANSWER

"If your father heard your stupid answers, it would make him turn over in his grave."

"It couldn't. He was cremated."—*Charles A. Hall.*

THIS WAS A KNOCKER

AVIATOR (after doing a tail spin): "What's that peculiar knock I hear?"

PASSENGER: "Oh, that's just my heart!"—*Clifton Ask.*

LOCAL INTERFERENCE

BASHFUL MAID TO SUITOR: "Don't you think you had better go now?"

ABSENT-MINDED RADIO ANNOUNCER: "Er—a—yes, good-night. W-S-O-S signing off at 11:45 Eastern Standard Time."—*H. Edw. Bennett,* Reporter No. 13,211.

A LABORIOUS LOCHINVAR

HE: "When I first saw you, your beauty electrified me."

SHE: "When I first saw you your dumbness shocked me and your sparking disgusted father, while your gassing asphyxiated mother."—*Richard Barrett.*

COLD FEET, NO DOUBT

Student coming from laboratory after examination. "Congratulate me old top, at last I have made a scientific achievement."

SECOND STUDENT: "What is it?"

FIRST STUDENT: "I have obtained absolute zero."—*Olin T. Mathews.*

AND THAT AIN'T ALL

PROF.: "What did Archimedes discover when he was taking his bath?"

BRIGHT BOY: "Dirt."—*Marshall Smith.*

HE'S QUICK

The man next door describes electricity as being the soonest stuff he ever knew of.—*Les Van Every.*

SOCIAL PARADOX

"Ho, hum!" yawned the electric fan, "I give a lot of people a cool reception, but they like me for it."—*Les Van Every.*

A SHOCKING ANSWER

LITTLE BOY TO FATHER: "Papa, why do people call an old horse a 'plug'?"

BOY'S FATHER: "'Cause they only have a spark of life left in them, son."—*Harry Walters,* Reporter No. 13,835.

A HANDSOME DEFINITION

"What is the difference between a radio bug and a bankrupt business?"

"One takes receivers in hand—receivers take the other in hand."—*Sam Y. Caldwell.*

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THE ORACLE

The "Oracle" is for the sole benefit of all scientific students. Questions will be answered here for the benefit of all but only matter of sufficient interest will be published. Rules under which questions will be answered:

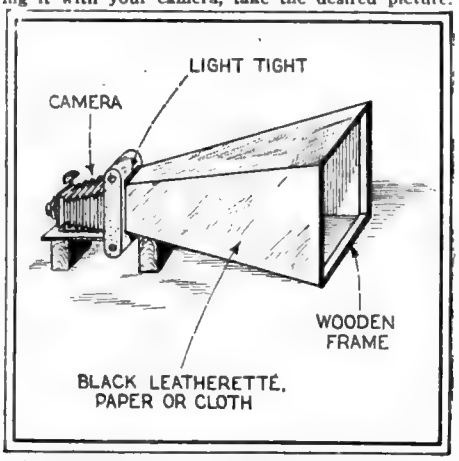
1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of 25 cents is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

PICTURE ENLARGER

(1783). Jack Kunz, Guttenberg, New Jersey, says he has a 3A Kodak and desires to magnify small insects such as flies ten or fifteen diameters. He asks:

Q. 1. Will you kindly describe the process of doing this?

A. 1. In order to take enlarged pictures such as you desire with your 3A Kodak, it will be necessary to add an extension in the form of a large rectangular frustum such as shown in the picture herewith. You can, however, instead of using this, obtain a double convex lens, placing it at the focal distance from the object and viewing it with your camera, take the desired picture.



By constructing a rectangular frustum from narrow strips of wood and covering the whole with black leatherette paper, a handy picture enlarger is obtained.

THE EYE

(1784) Robert Hayes, Baltimore, Md., asks:

Q. 1. Is it true that the image on the retina of the eye is inverted and that the brain rectifies it?

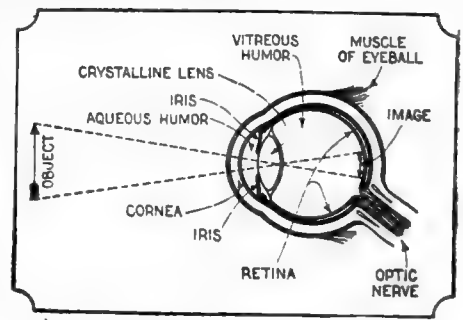
A. 1. Every object seen, no matter at what distance, always gives an inverted image on the retina.

Q. 2. Can you give me more information about the eye?

A. 2. The human eye resembles a camera in many respects. It has a series of convex lenses, a cornea, aqueous humor, vitreous humor and crystalline lens in order to form a clear image of a near or distant object on the retina, the screen at the back of the eye. A shutter, the eye lid, excludes the light when the optic is not in use and an iris diaphragm, the iris, regulates the amount of light entering. A great variety of marvelous intricate bits of mechanism, tiny muscles, move the orb about and point it toward the object to be seen. In its normal state, the eye is a far more wonderful instrument than the camera. In the first place, it is automatically focused both for near and distant objects, although not by a to and fro movement of the lens as in the camera, but by a change in the focal length of the crystalline lens itself—a device that man has never been able to duplicate. Secondly, the entire surface exposed to the air is kept clean and moist by the automatic process of sponging, for by the act of winking, the eye is washed with a saline solution every few seconds. It is thus not hard to see that a complete study of this wonderful organ would be intensely interesting and highly instructive, but it is not possible to give full detail about the eye in the small space here available. The most common defects of the eye are as follows:

Nearsightedness or myopia is usually due to the fact that the retina is too far from the cornea so that the rays of light from a distant object are brought to a focus in front of the retina. That is, a person suffering from this defect of the eye can see clearly only those objects which are close to him. To correct this fault, a concave lense is fitted to the eye and has the effect of pushing the image back to the retina.

Farsightedness or hypermetropia is usually due to the fact that the retina is too close to the cornea so that the rays of light from an object not very distant, are brought to a focus behind the retina. Thus a person suffering from this defect of the eye can see clearly only those objects which are further distant. To correct this fault, a convex lens is used to bring the image back to the retina.



What a wonderful and intricate piece of mechanism is the human eye! Note how every object seen is inverted on the retina and conveyed to the brain which rectifies it.

Astigmatism is due to a defect in the curvature of the cornea and of the crystalline lens so that the rays of light from an object are not all brought to the same focus and the image is not, therefore, sharply defined. A person suffering from this defect of the eye cannot see anything distinctly, though in many cases he is not aware of this fact until his eyes have been tested by an oculist and the proper lens adjusted to them.

It is a well known fact that defects of vision place a serious strain upon the nervous system and are often the unsuspected cause of headaches, indigestion, dizziness and even of apparent dullness. It must be remembered that the eyes are our most wonderful organs and that we should be very careful of our vision.

Interesting Articles to Appear In January Issue of "The Experimenter"

How to Make the New Mercury Electro-Generator, By C. A. Oldroyd.

Simple Experiments in Chemistry, By Raymond B. Wailes.

Striking Experiments in Diffusion, By Earle R. Caley.

Single Tube Reflex Experiments with the Hook-Up Board, By Clyde J. Fitch.

How Much Does Your Amplifier Amplify? By William Grunstein.

A Detector and Two-Stage Amplifier Unit, By Leon L. Adelman.

OUR $12,000 PRIZE CONTEST

IT will be noted from recent issues and the present one that our prize contest has been a whale of a success. Over $1,500 has been paid out this month for worth while contributions to SCIENCE AND INVENTION, either in pictures, suggestions, ideas or articles. We now have on our staff, close to 16,000 correspondent reporters who are scouting the world for new material that can be written up for SCIENCE AND INVENTION. And the formula is simple—just keep your eyes open. Even if you were totally deaf or blind, you could still win a prize by simply using your head and sending us ideas of a scientific nature, or of a nature directly or indirectly attached to new inventions.

FURTHER ARTICLES FOR FEBRUARY SCIENCE AND INVENTION

Cold Light Substitute for X-Rays
How to Etch Metal
Gas Warfare and Methods of Combatting It
Our Digestive System, By Ismar Ginsberg, B. Soc., Chem. Eng.
Latest Movie Exposés
Hot Air Versus Steam and Hot Water Heat, By H. Winfield Secor
Animals That Make Themselves Invisible, By Dr. Ernest Bade.
How to Make Rubber Balloons
Useful Cements—How to Make Them
A New American Helicopter—How It Flies
Everyday Chemistry, By Raymond B. Wailes.
Vacuum Tube Testers, By Leon L. Adelman.

FREE INFORMATION

IF you want additional information concerning any of the subjects illustrated and described in this number of SCIENCE AND INVENTION we shall be glad to give you other data we have at our command. To make this work as easy as possible for our editors, please be brief. Write only on one side of the paper and state exactly in a few words just what it is you desire further information on. We have the original manuscripts and drawings of many of these articles in our files and can furnish much additional data in most cases. Please do not fail to send stamped and self-addressed envelope. Make all questions concise and specific.

Address all inquiries of this nature to **INFORMATION EDITOR** c/o Science and Invention, 53 Park Place, New York City.

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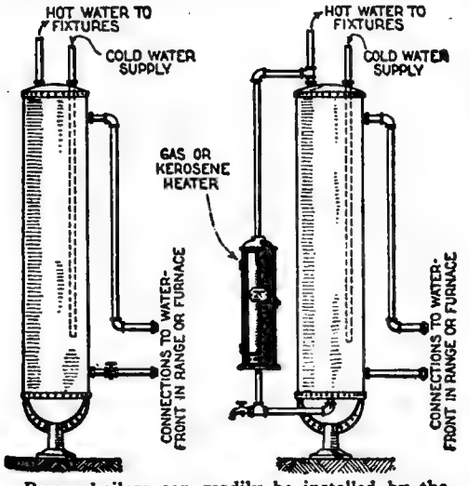
RANGE BOILER CONNECTIONS

(1785) James R. Lundey, Jacksonville, Fla., says he has recently purchased a boiler for installation in his country bungalow and would like to install it himself. He asks:

Q. 1. Can you kindly give me piping connections for use with and without the use of gas or kerosene heater?

A. 1. As clearly shown in the drawing, the connections to the waterback of the stove and those to the boiler are depicted. It has been found that if pipe connections are made six inches from each end of the boiler, the best arrangement is obtained. The standard boiler


HOT WATER TO FIXTURES
COLD WATER SUPPLY
GAS OR KEROSENE HEATER
CONNECTIONS TO WATER-FRONT IN RANGE OR FURNACE
HOT WATER TO FIXTURES
COLD WATER SUPPLY
CONNECTIONS TO WATER-FRONT IN RANGE OR FURNACE

Range boilers can readily be installed by the average layman. The above diagram shows how to do it properly so as to pass the fire underwriters' rules.

sizes and tappings make it entirely possible for you to do the entire job yourself, thus effecting a great saving. For quickly heating the water in the boiler, both the waterfront and the gas heater connections can be used. At any rate, care must be taken to insure watertight connections and that the boiler is fastened in such a way as to entirely meet the requirements of the underwriters.

LIQUID AIR

(1786) Albert Gee, Milwaukee, Wis., asks:

Q. 1. Who first liquified air and how?

A. 1. About 1878 Cailletet in Paris and Pictet in Geneva, both liquified air. The method used was to subject the gases to great pressure and cool them to the lowest point attainable, by evaporating liquid sulphur dioxide under diminished pressure.

The compressed gases were then allowed to suddenly escape and the cooling resulting from the expansion was sufficient to cause condensation.

The present day methods of obtaining liquid air on a large scale were devised by Dr. Linde in 1895, and by others, and are based on the progressive cooling of a stream of escaping gas, by its own expansion. The French scientist, Georges Claude is one of the highest authorities on the subject.

HELIUM

(1787) Charles Marcos, Bridgeport, Conn., wants to know:

Q. 1. What is the density and boiling point of helium?

A. 1. Helium boils at minus 268.5° C. and has a density of 0.15.

ELECTRO-PLATING FISH

(1788) Kary Canatsey, Idola, Kansas, wants to know:

Q. 1. Kindly give me complete information as to how the fish was electro-plated as described in the July issue.

A. 1. The process for electroplating the fish is as follows:—

Use an ordinary plating solution of the same strength as is used in small metal work. The current strength is two amperes at 4 to 6 volts. The fish is first thoroughly cleaned on the inside, it being cut open by a long slit in one side. It is then filled with molten wax or other plastic material.

The fish when prepared is fresh from the water, having just been caught. It is given a coat of shellac and then coated with graphite. It is then placed in the plating solution. Care must be taken in handling as the fish will collapse if not properly stuffed and if the plating solution and current density are too strong.

WEATHER FORECASTER

(1789) A. E. Serviss, Baltimore, Maryland, asks:

Q. 1. How is a storm glass made and how is it read?

A. 1. The method of making a storm glass is as follows: Two and one-half drachms of camphor are dissolved in 11 drachms of alcohol, while 38 grains each of saltpeter and sal ammoniac are dissolved in 9 drachms of water and the two solutions are mixed. The mixture is then poured into a test tube which is carefully corked and sealed. A pin hole is made in the cork by forcing a red hot needle through it. Fine weather is indicated by the presence only of the clear liquid with a sediment (somewhat like a precipitate) on the bottom of the tube. Rain is indicated by a steady rise of the sedimentary deposit, the liquid being very clear. An approaching storm is indicated by the appearance of the substance at the top of the tube in a leaf-like form, the liquid being in a turbid and fermented state. In winter the substance is generally whiter and nearer the top than in summer. If a portion of the substance crystallizes on one side of the tube, winds may be expected from that direction.

Q. 2. What is the weight of the earth and what is the density upon which it is computed?

A. 2. The weight of the earth is six sextillion tons. The result is based on using an average density of 5.52.

EFFICIENCY OF BOILERS

(1790) Maxwell J. Fine, Oklahoma City, Oklahoma, asks:

Q. 1. What is the efficiency of up-to-date large steam boilers?

A. 1. According to exhaustive tests conducted by the Babcock & Wilcox Co. the average efficiency of steam boilers lies between 50% and 60%.

Using a good grade of anthracite whose heat value approximates 14,800 B. T. U. per pound, equal to the heat required to evaporate 15.26 lbs. of water from 212° F, with an efficiency of 60%, only about 9.15 lbs. of water will be evaporated by one pound of coal. There are several important questions to be taken into account; the quality of the coal, the purity of the water, the thickness of the scale in the boiler and the care in firing. All are important in determining the practical efficiency.

IMPORTANT

TO NEWSSTAND READERS

IN order to eliminate all waste and unsold copies it has become necessary to supply newsstand dealers only with the actual number of copies for which they have orders. This makes it advisable to place an order with your newsdealer, asking him to reserve a copy for you every month. Otherwise he will not be able to supply your copy. For your convenience, we are appending herewith a blank which we ask you to be good enough to fill in and hand to your newsdealer. He will then be in a position to supply copies to you regularly every month. If you are interested in receiving your copy every month, do not fail to sign this blank. It costs you nothing to do so.

To ..... Newsdealer

Address .....

Please reserve for me.....copies of SCIENCE & INVENTION every month until I notify you otherwise, and greatly oblige,

Name .....

Address .....

PRESSED FUEL

(1791) Henry Miller, Washington, D. C., asks:

Q. 1. How is pressed fuel made?

A. 1. Anthracite dust is mixed with 10% of its bulk of dry pitch. The pitch is obtained by the fractional distillation of tar, at a temperatue of 572° F. The mixture is heated by steam to 212° F., at which temperature the pitch acquires its cementing properties. It is then passed between two rollers on the periphery of which are a series of semi-oval cavities, thus pressing the mass into about the shape of an egg. The globules are then cooled for several minutes and are ready for shipment. Sometimes sawdust is mixed with it. Thus ordinary waste coal dust is converted into a valuable product.

BEAUFORT WIND SCALE

(1792) James V. Grant, Poughkeepsie, N. Y., asks:

Q. 1. Kindly publish the Beaufort wind scale.

A. 1. The scale you desire is given below:

		Miles per hr.
0	Calm	0-3
1	Light air	3-8
2	Light breeze	8-13
3	Gentle breeze	13-18
4	Moderate breeze	18-23
5	Fresh breeze	23-28
6	Strong breeze	28-34
7	Moderate gale	34-40
8	Fresh gale	40-48
9	Strong gale	48-56
10	Whole gale	56-65
11	Storm gale	65-75
12	Hurricane	75-

THERMO-COUPLES

(1793) John Larimer, Staten Island, New York, wants to know:

Q. 1. What metals are used in sensitive thermo-couples?

A. 1. Thermoelectric pyrometers employ platinum against platinum-iridium or platinum-rhodium alloys for high precision work. The alloys contain 10% of iridium or rhodium. The cost of these thermo-couples, however, is very high, so for industrial purposes, cheaper metals and alloys are used, such as copper, nickel and iron.

The melting point of pure tungsten is 2900° C or 5252° F.

WOOD

(1794) Richard Langley, Philadelphia, Penna., asks:

Q. 1. Will you kindly publish a list of the various useful woods?

A. 1. We are giving you the list you desire below:

Alder	Apple	Ash
Box	Cedar	Cherry
Dogwood	Ebony	Elm
Hemlock	Hickory	Holly
Ligmun vitae	Linden	Locust
Oak, Live	Oak, White	Oak, Red
Spruce	Sycamore	Teak
Balsa	Bamboo	Beech
Chestnut	Cork	Cypress
Fir	Gum	Hackmatack
Juniper	Hornbeam	Larch
Mahogany	Maple	Mulberry
Pine, White	Pine, Yellow	Poplar
Walnut	Willow	

Balsa wood is the lightest, weighing only 10 lbs. per cubic foot, ebony being the heaviest, weighing 76 lbs. per cubic foot.

FALLING HAIR

(1795) Joseph H. Krantz, Woodridge, New York, asks:

Q. 1. Is there anything that I can do to prevent the continual loss of hair?

A. 1. The head must be thoroughly cleaned; first by washing and then by shampooing.

A preparation of salicyclic acid 1 part, precipitate of sulphur 3 parts and rose water 25 parts are rubbed into the scalp in a most thorough fashion. This will stimulate the hair follicles and sebaceous glands to activity.

The treatment is continued for five nights, when on the sixth and seventh, shampoos are in order. By steady application and perseverance over a period of from four to eight weeks, the hair becomes more lifelike and in most cases will begin to take a firmer hold with a luxurious growth resulting.

Q. 2. What is Pinaud's Eau de Quinine composed of?

A. 1. The composition of this hair tonic is as follows:

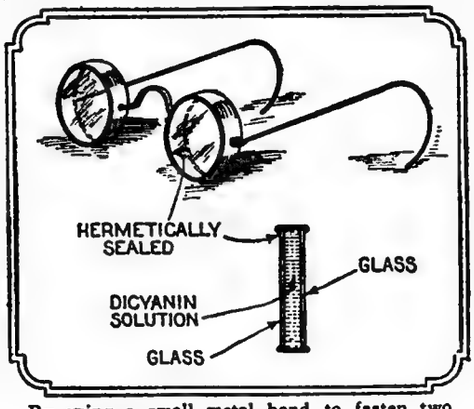
Quinine Sulphate, 2 parts.
Tincture of krameria, 2 parts.
Spirit of lavender, 10 parts.
Glycerine, 15 parts.
Alcohol, 100 parts.

DICYANIN GLASSES

(1796) Milton Brady, Philadelphia, Pa., asks:

Q. 1. How can I make a pair of dicyanin glasses so as to enable me to view the human aura?

A. 1. Very little success as yet has been accomplished by the means of using dicyanin glasses to view the human aura. You can readily make a pair of such glasses by getting two pairs of cheap glasses and fastening them together about



By using a small metal band to fasten two pair of glasses together with the aid of a bit of sealing wax, so-called "dicyanin glasses" for viewing human aura are readily made.

⅛th of an inch apart after having filled the space between them with an alcoholic solution of dicyanin. A very dark room and a solution of the correct strength, which can be obtained only through experimentation, may enable one, with a vivid imagination, to view the human aura.

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Awards in $1000 Monthly Contest

The Regular Departments Pay Prizes of Their Own. Authors on Contract Receive Their Own Rates; this, With Other Special Payments Makes the Total Paid for Articles in Excess of $1500.00 Monthly.

FIRST PRIZE $100.00

Models of Famous Inventions, by Walter Sonneberg.....884 and 885

SECOND PRIZE $75.00

Solar Eclipse, by Donald H. Menzel, Ph.D. .....890 and 891

TWO PRIZES OF $50.00 EACH

Solar Eclipse of Jan. 24, 1925, by Isabel M. Lewis, M.A. 889
Nature of Heat in Experiments, by Raymond B. Wailes ..... 898 and 899

THREE PRIZES OF $35.00 EACH

Unique Clocks, by H. E. Zimmerman 877
Burning Oil Forms Defense, by L. B. Robbins 878
A Remarkable Six Tube Receiver, by Grandon Lyons 911

FIVE PRIZES OF $25.00 EACH

The Snow Burner, experiment suggested by Harry E. Hale..... 870
Little Known Dirigible Facts, by Wm. P. Sullivan, M.E. 874
Mystifying Juggler Tricks, by L. J. Smith 892
Amateur Surveyor's Transit, by H. E. Balfour 901
Tool Set from Old Files, by G. A. Luers 902

FIVE PRIZES OF $20.00 EACH

Building Houses While It Rains, by J. G. Pratt 871
Future Zeppelin Design, suggested by J. Von Stein 875
Steam-Driven Model Boat, by Dr. Ernest Bade 900
Drill Press, by Harry B. Luessen 902
A Miniature Crystal Set, by W. J. Rittall 910

TEN PRIZES OF $15.00 EACH

Swiftly Growing Plants, by S. Leonard Bastin 879
Cloud Filter, by Charles T. Belden 900
Housewife's Sink Kink (author please send address) 901
Sugar Motor, by Dr. Russell G. Harris 902
Thermit Welding Simplified, by Chas. D. Tenney 904
Battery Control Panel, by Evermont Fiesel 945
Crystal Standby, by Samuel M. Malkin 947
Unique Vernier, by Irving Mower 947
Radio Chandelier, by Donald Crow 949
Duplex Tuning Unit, by George E. Johnson..... 950

FIFTEEN PRIZES OF $10.00 EACH

Jensen Clock, by Joseph Lukacs 877
Prague Clock, by Herbert Slouka 877
Compass, by Dr. Alfred Gradenwitz 879
Heater, by John P. Stoddart 901
Trap Drums, by John W. Reed 903
Vanishing Smoke, by Francis D. Wittemore 903
Hygrometer, by L. M. Bingaman 904
Screen Stretcher, by Edward Evers 904
Loud Speaker, by L. I. Dupuy 946
Battery Switch, by L. Ringer 946
Tin Can Cover Dial, by E. R. Gilmore 948
Multiple Detector, by F. J. Bruno 948
Panel Detecetor, by Samuel M. Malkin 949
Jack Switch, by Halbert H. Clark 950
Tangential Control, by E. M. Abbott 950

TEN PRIZES OF $5.00 EACH

Watch Compass, by Dr. Albert Neuburger 900
Burning Steel, by A. A. Blumenfeld 903
Savings Bank, by E. Corral 904
Top Remover, by Ingolf Kvamme 904
Can Opener, by Edward Evers 904
Simplified Spirals by J. Mursand 904
Removing Stains, by Howard C. Kramer 904
Simple Switch, by A. Horsfall 945
Rheostat Dial, by George Vatcher, Rep. No. 9608 946
Socket Suspension, by J. Futterman 948

FIFTEEN PRIZES OF $2.00 EACH

Vernier Dial, by R. H. Watkins 948
Location Finder, by K. Liu 949

(No further Entries)

$13,320.00 in Prizes Paid Last Year

WITH the December issue our $12,000 a year prize contest came to a happy conclusion. Not only did we pay out $12,000 in prizes as announced in our November, 1923 issue, but we did actually pay out in prizes alone, not less than $13,320.00 to 1,112 winners. These prizes every month ranged from the first prize of $100.00 down to the smallest prize winner of $1.00 each.

Up to the time of going to press, SCIENCE & INVENTION had no less than 18,590 reporters scattered over every section of the globe. These reporter-contributors have sent in an avalanche of material, and their efforts have been fruitful in that they have won prizes.

SCIENCE & INVENTION aims to print the news first, if it is interesting and to otherwise excel in the reporting of science and invention. Small wonder then that with the enthusiastic co-operation of our thousands of Reporter-Correspondents, SCIENCE & INVENTION today occupies an enviable position in the scientific press.

The $12,000.00 prize arrangement has worked out so satisfactorily during the year just closed that we have decided to extend it for another year and we hope that our correspondents will be as successful in winning prizes for the coming year as they have been during the past one. We wish to thank all of our friends for their co-operation and wish them the best of luck for the coming year.

Note New Prize Schedule.

Here Is How You Can Get in the Contest:

$12,000 or More in Gold

EVERY month SCIENCE AND INVENTION pays $1,000 or more in gold in prizes. Every text article published will receive a prize—(most of the departments have awards of their own which they give every month). Ideas are what the Editors want. The ideas must be told simply, so that your mother or your sister can understand them—in pictures or sketches or both. But the idea must be new and must have something to do with science or invention.

The Editors want pictures and sketches—must have them—but what they want most

82 monthly prizes will be given as follows:

FIRST PRIZE			$100.00
SECOND PRIZE			$75.00
2	PRIZES OF		$50.00 each
3	"	"	35.00 "
5	"	"	25.00 "
5	"	"	20.00 "
10	"	"	15.00 "
15	"	"	10.00 "
10	"	"	5.00 "
15	"	"	2.00 "
15	"	"	1.00 "

$12,000 or More in Gold

is IDEAS. These ideas will be handsomely paid for. We have published a pamphlet showing the rules of the contest which we shall be glad to send to anyone free on receipt of a postal card with your name and address. The pamphlet gives full details, the rules and how to submit articles. The magazine itself shows you what is wanted. Study it closely and submit your ideas.

The closing date for all prize contributions is the 15th of the month preceding date of issue, *i.e.*, the 15th of Jan. for the March. issue, the 15th of Feb. for the April issue, etc.

WILL YOU BE OUR REPORTER?

IN connection with our $12,000 prize contest announced herewith, it goes without saying that you will have to do a little work in order to win a prize. The Editors do not wish to make it hard for you, quite the contrary. We want pictures and ideas and we cannot have too many of them.

Herewith is reproduced our reporter's card. Up to now we have issued over 18,000 of these. Note in our awards how our reporters are winning prizes right along. We shall be glad to send the reporter's card free to anyone who makes an application for it. By means of this card you will be able to secure entry into industrial plants, business houses, motion picture studios, steamships, docks, public buildings, etc. This reporter's card will prove an open sesame to you in many instances. Every card is numbered and only one is given to a correspondent. A postal card from you and a request for this reporter's card is all that is necessary to obtain one. It will be sent to you by return mail. With it we will send you a pamphlet giving rules of the contest and how to proceed in order to get photographs, to send in sketches, and other information in order to obtain a valuable prize. Not only will this card help you to obtain material for this magazine, but it will train you to become a news gatherer, and will be the means of helping you to earn a good deal of money during your spare hours.

Address Field Editor, SCIENCE AND INVENTION, 53 Park Place, New York

REPORTER

Science and Invention

CORRESPONDENT REPORTER'S IDENTIFICATION NO. 10000

THE BEARER OF THIS CARD L. H. Shackney IS AN AUTHORIZED CORRESPONDENT-REPORTER OF SCIENCE and INVENTION MAGAZINE THE PUBLISHERS OF SCIENCE AND INVENTION WILL APPRECIATE ANY COURTESY EXTENDED THEIR REPRESENTATIVE.

EXPERIMENTER PUBLISHING CO.

(over) Hugo Gernsback PRESIDENT

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FREE--25c Book on Wood Finishing

Tells You How To Finish Radio Cabinets

If you have a hobby for making radio cabinets, furniture, work benches, etc., you will find our Book invaluable for, naturally, you want to give your handiwork as beautiful a finish as possible.

This Book gives complete instructions for finishing all wood—hard or soft—old or new. It is the work of experts—beautifully illustrated. Gives covering capacities—includes color charts, etc. Use coupon below.

JOHNSON'S WOOD DYE

(*Penetrating*)

Johnson's Wood Dye is very easy to apply. It dries in four hours and will not rub off or smudge—penetrates deeply, bringing out the beauty of the grain. Johnson's Wood Dye is made in 17 popular shades as follows:

No. 128 *Light Mahogany*
No. 129 *Dark Mahogany*
No. 127 *Brown Mahogany*
No. 329 *Red Mahogany*
No. 120 *Fumed Oak*
No. 123 *Dark Oak*
No. 126 *Light Oak*
No. 124 *Golden Oak*
No. 160 *Brown Oak*
No. 125 *Mission Oak*
No. 130 *Weathered Oak*
No. 110 *Bog Oak*
No. 172 *Flemish Oak*
No. 178 *Brown Flemish*
No. 131 *Walnut*
No. 140 *Early English*
No. 180 *Gray*

All shades may be easily lightened, darkened or intermixed. Full directions on every label. Select the shade of Dye you want from the list above and order it from your dealer by name and number.

S. C. JOHNSON & SON, Racine, Wis., U. S. A.
"The Wood Finishing Authorities"

Johnson's Wood Dye is a dye in every sense of the word. It contains no finish whatsoever. Like most first class products it answers one purpose only—it dyes the wood—the finish must be applied over it. We recommend Johnson's Varnishes or Johnson's Polishing Wax.

Ask for a FREE copy of the Johnson Book at the best Paint or Hardware Store in your locality. Stores displaying the Johnson Service Department Sign shown below can furnish the Book and full information on how to finish wood the proper way.

S. C. JOHNSON & SON, Dept. S. I. 1, RACINE, WIS.
"The Wood Finishing Authorities"
(Canadian Factory—Brantford)

Please send me free your Instruction Book on Home Beautifying and Wood Finishing. I enclose 10c to cover postage and wrapping.

MY DEALER IS.....
My Name .....
Address .....
City and State.....

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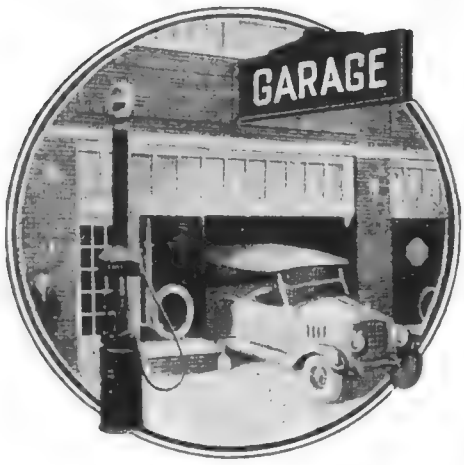
MEN WANTED

for highly-paid repair work on 16,000,000 Autos



We Want Men

WE WANT MEN to learn the Auto and Garage Business. Right now there are more calls for Greer Trained Automobile men than we can supply. **In 8 weeks we will make YOU an Auto or Garage expert and get you a job.** You can be either an expert Auto, Truck or Tractor Repairman—Shop or Garage Manager—Salesman—Machine Shop Man—Battery Man—Tire Vulcanizer and Repair Man—Welder—Chauffeur—Electrician—anything you want to be in the Automobile, Garage or Accessory business. We train you and start you earning. Mail the coupon today for Free Book and Special Offer.

WE HELP YOU

Go In Business For Yourself

18 months ago one of our graduates started in business for himself with a capital of $400. Today his business is worth $30,000. Another graduate now averages $400 to $500 per month profit after 8 months in business. Another has retired—independent at 40—his 8th year out of our shops. Out of more than 40,000 men we have trained, over 30,000 are now in business for themselves. You, too, can do what these men have done. Let us train you and help you get started in business for yourself. You can at least double your present earnings.

EARN WHILE YOU LEARN

We offer you a chance to earn while you learn. Our FREE EMPLOYMENT DEPARTMENT has secured thousands of part time jobs for men who have learned the auto Business in the big Greer Shops. This is a wondeful opportunity for you. See it and seize it. Mail the coupon to me today for complete offer.

FREE

This big AUTO BOOK is FREE to those who mail the coupon below. Many pages and pictures on Automobiles and Shop Training. Get it to-day—and study my Big Special Offer that comes with it.

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ERWIN GREER, President,
Greer College of Automotive Engineering,
2024 S. Wabash Ave., Dept. 2903, Chicago, Ill.

Please send me FREE Book "How to Succeed in the Auto & Tractor Business" and Special Training Offer. This request does not obligate me in any way.

Name .....

Address .....

Doctor Hackensaw's Secrets

By CLEMENT FEZANDIÉ

(*Continued from page* 887)

the weather. So nowadays, whenever a child is born, all the hairs are destroyed at the roots and we therefore no longer have hair of any kind—neither hair nor beards. Our teeth, too, are destroyed at birth, in the bud, before they begin to plague us. You cannot imagine how strange it seemed to me to see both of you with teeth."

"Not stranger than it did to us to see that you had no teeth. The lack of teeth makes a person look awful!" cried Pep.

"Does it? Well, if you listen to the newspaper account, you will see that the thing that struck the public as most frightful about you, was not your hairiness, but your ferocious-looking teeth that make you look like cannibals. We destroy them,—not only to avoid future pain, but because teeth furnish breeding places for microbes. Our gums become somewhat hardened, and as we use only soft food, and it is predigested, we no longer need teeth. Only animals that tear or chew their food require teeth. But excuse me a minute, there's a man I should like to meet."

She left then, but returned a couple of minutes later. "It's all right," she said. "I've invited him to take an air-ride with me this afternoon."

"He's a friend of yours?" asked Pep.

"No, I never met him before. But I liked his appearance, so I looked at his identification button to see his number, and I telephoned to the newspaper and got full particulars about him. As they were satisfactory I went up to him and invited him. He telephoned to the paper for particulars about me, and they must have been O. K. or he wouldn't have accepted my invitation."

"Gee!" cried Pep, "I wish I had the nerve to go up to every handsome man I see and ask him to take me on a joy-ride!"

"I knew there was no fear of his refusing. My father is head of the Microbe Factory."

"What!"

"Yes, he manufactures microbes by the ton and ships them to every part of the world. Of course only a small proportion of these are health microbes for fighting disease. Most of them are for industrial purposes—agricultural microbes for securing the proper fertilization of the soil, chemical microbes for aiding the different chemical processes, dairy microbes for butter and cheese-making, fermentation microbes for producing alcohol, etc., etc. He manufactures thousands of varieties and immense quantities of each. His factory is on Manhattan Isle—all that is left of what once was the whole of New York City."

"Why, what happened to Manhattan Island?"

"It has gradually sunk and been covered by the sea. It is now a part of New York Bay."

"Excuse me for changing the subject," said Pep, "but what must we do to get the hundred thousand dollars the Daily Broadcaster promised us."

"It has already been placed to your credit at the store. We don't use money any more. Everything is done by credit. Money was filthy and served to carry around disease germs. Besides, money led to theft. Credit is much safer. If a store has reason to doubt your solvency it telephones to the central store to know if your credit is good for the amount. Your thumb-print is your signature. It cannot be counterfeited for it is made in the presence of the clerk. Nor can your credit be counterfeited."

"One thing that strikes me as peculiar," said Doctor Hackensaw, "is that I see no advertisements. I expected to see advertisements everywhere, recommending 'Pitt's Pills,' or Susy's Soap."

"Advertising isn't allowed," replied Electra, "or, at least, it is restricted within certain very narrow limits. At one time, about the year 2000 advertising had become an unendurable nuisance. The walls of the houses, the streets, the pavements, the vehicles and even the sky were covered at all times with glaring and changeable advertisements. At night-time it was even worse than in the day-time, for the signs consisted of myriads of constantly changing electric lights of different colors. Even the X-rays were used and advertisements projected through the walls of your house into your very bed-room. As if that were not enough, loud speakers constantly dinned into your ears the merits of 'Birch's Buttons' or 'Peter's Pants' till people were driven wild, and stringent laws were passed to regulate advertising, confining it to books and periodicals. All publications were given away free to the public, the advertisers paying all expenses. You could choose a library of whatever books you wanted and they would be sent you free, with thanks for accepting them. And the publishers were very particular about the advertising they accepted, for they found that the more particular they were to publish only advertising of the first class, the more eager the advertisers were in applying for space, even though they paid all the expenses of publication. And then the end of all advertising came about in the very simplest way by the formation of the 'General Purchasing Agency,' which does all our buying for us. If you want anything from a pin to a house, from a rhinoceros to a wife, a postage stamp or a theatre ticket, you stop in at the company's nearest office—they have one on every block—and place your orders. You are sure of getting the object best suited for your purpose that can be obtained anywhere for the price you are willing to pay. They sell cheap qualities but no 'shoddy,' and they even deal in second-hand goods, taking any objects you wish to get rid of at fair valuation.

"That killed advertising. It was no longer necessary for men to persuade you that Pinch's Pills were the best by dinning it into your ears or flashing it into your eyes by brilliant lights or moving pictures thrown on the clouds. In the year 1900 advertising was a highly useful form of education, for it was necessary to hypnotize the people by constant reiteration to impress a fact on their minds and teach them about new products. But it was most expensive and annoying, and was getting so bad something had to be done to stop it. A man would have to pay nearly double the price for goods if we had to go back to the old system. The agency will hunt up for us any article we wish, or will manufacture one for us if unable to find it. If you let them know what things you are interested in—what kind of plays or books you like, they will send you full information about anything new that comes up in that line. They make a specialty of preparing individual programs of entertainments for home enjoyment—sending you by telephote portions of the best acts on the boards at the time, selecting them to suit your taste, which they soon learn to know. You thus see the very best of the novelties and don't have to sit through any 'chasers.'"

(*Continued on page* 924)

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No. 772
45-*volt*
large
vertical
Price
$3.75

No. 766
22½-*volt*
large
horizontal
Price
$2.00

Dry "B" Batteries are more economical and more dependable than any other source of plate current!

Cut your operating cost

THIRTY years' experience in the manufacture of dry batteries has enabled us within the past two years to steadily and greatly improve dry "B" Battery quality. Eveready "B" Batteries are now from two to three times better than ever before.

Eveready "B" Batteries will long outlast any others, and are the most economical and dependable source of plate current. These are strong statements, but they have been proved by tests in our own and in independent laboratories. Check them for yourself on your own radio set. Get Eveready "B" Batteries.

There is an Eveready Radio Battery for every radio use.

Manufactured and guaranteed by
NATIONAL CARBON COMPANY, INC.
Headquarters for Radio Battery Information
New York San Francisco
Canadian National Carbon Co., Limited, Toronto, Ontario

EVEREADY
Radio Batteries
—they last longer

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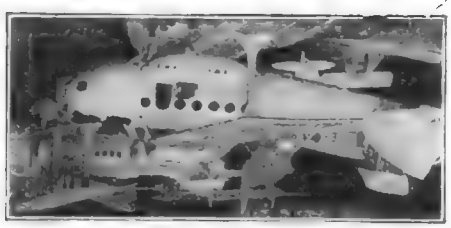

Aviation Brings Quick Success

TO young men of daring no other field of work offers such a fascination, such high pay, nor such opportunities for quick success as the field of Aviation. As yet, aviation is practically in its infancy. But now is the time to get in.

Amazing Opportunities in Airplane Industries

In the automobile industry and in the moving picture business hundreds of men got rich by getting in at the start. They made their success before others woke up. Today, these lines offer no greater opportunities than a hundred and one others. BUT AVIATION IS NEW. Get in while the opportunities are big. All over the country there will be a clamor for trained men. It will not be a question of pay but of getting capable men.

Become an Aviation Expert $50 to $100 per Week

The study of aviation is almost as fascinating as the actual work. Every lesson is full of interest. That is why it is easy to learn aviation. You do not have to make yourself study—it is like reading an interesting book that tells you things you have always wanted to know. Only one hour each evening will give you the basic training in a surprisingly short time.

One student, S. F. McNaughton, Chicago, says: "Your lessons are like a romance, and what is more, after one reading, the student gets athorough understanding. One never tires of reading them." James Powers, Pa., another student, says, "I am indeed surprised that such a valuable course can be had from such practical men for so little cost."

Fascinating —Daring— Big Paying

Prepare Now for One of These Positions

Aeronautical Instructor $60 to $150 per week
Aeronautical Engineer $100 to $300 per week
Aeronautical Contractor Enormous profits
Aeroplane Repairman $60 to $75 per week
Aeroplane Mechanician $40 to $60 per week
Aeroplane Inspector $50 to $75 per week
Aeroplane Salesman $5000 per year and up
Aeroplane Assembler $40 to $65 per week
Aeroplane Builder $75 to $200 per week

Personal Instruction

by Experienced Men

Men who have had actual experience give you personal attention. They select the lessons, lectures, blueprints and bulletins. They tell you things that are essential in everyday practice. Each lesson is easy to read and understand.

Get Big FREE Book—Now

Send coupon below for New Book, just out, "Opportunities in the Airplane Industry." It is interesting and instructive. It will show you many things you never knew before about aviation. We have but a limited supply of these books—send the coupon before they are all gone.

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American School of Aviation
3601 Michigan Ave., Dept. 14-21 Chicago, Ill.

Without any obligation, send me your Free Book, "Opportunities in the Airplane Industry", also information about your course in Practical Aeronautics.

Name.....

Street.....

City..... State.....

Doctor Hackensaw's Secrets

(*Continued from page 924*)

presence of the justice of the peace, to whom Pep at once began a voluble explanation of what had happened.

"Wait a minute!" said the judge. "Before you begin, as the room is somewhat chilly, I must ask the attendant to put another pebble in the crucible (they used atomic heat in those days, obtained by the disintegration of the atoms of stones into lighter elements). As for you," he continued, turning to Pep, "you must take your seat in the 'Chair of Truth.'"

So saying, he pressed a button, and as he did so, a peculiar looking arm-chair came walking into the room on its own four legs, automatically moved by some invisible mechanism. All kinds of thermometers, dials and instruments of every sort were attached to the chair.

"Sit there," said the judge. "Let your hands rest on the arms of the chair and tell me how the accident happened. If you prevaricate, exaggerate, or hold anything back, or tell an untruth, I shall know it immediately, for along with the phonographic record of your statement will be the 'graph' of your every heart-beat and the dilation and contraction of your blood-vessels and the nervous twitches induced in you by the various emotions of anger, fear, etc., that govern you while you speak. In a word I shall read your mind and know exactly how much confidence I can place in your statements."

Pep, somewhat frightened, sat down as she was bid and began her story again. But she had not spoken a dozen sentences before the magistrate interrupted her.

"It's no use going on," said he. "The electric light has turned green, and the heart-dial marks 33 degrees by Chubb's gauge. You may not think you are lying, but you are prevaricating at a great rate. Now begin over again and tell the full truth or I shall have to hypnotize you and get the full confession while you are in the hypnotic trance."

Thus admonished, Pep began over again, and this time she gave the exact facts. When she had finished the judge merely remarked:

"Guilty! And sentenced to pay the penalty!"

"But," sobbed poor Pep, "I didn't mean to do any harm."

"No, but you were reckless, and your recklessness caused the damage. You must make it good."

Here Doctor Hackensaw interposed. "I will pay for the broken arm," he said. "We have a credit of one hundred thousand dollars here."

"Money cannot pay for the suffering of a broken arm," returned the judge. "If the girl had been a thief and had merely stolen money, we should allow her to make restitution with an added fine to pay police expenses and to add to the fund from which restitution is made to robbed persons when the thief cannot be caught. In the present case the girl must make restitution."

"How can we make restitution for a broken arm?" asked Doctor Hackensaw, puzzled. "You don't mean that Miss Pepita's arm must be broken because she was unfortunate enough to break this man's arm?"

"No indeed! That would be as foolish as to condemn a murderer to death because he has killed a man. We force the murderer to make restitution to society for the life he has taken, and as he cannot re-

(*Continued on page 928*)

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Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

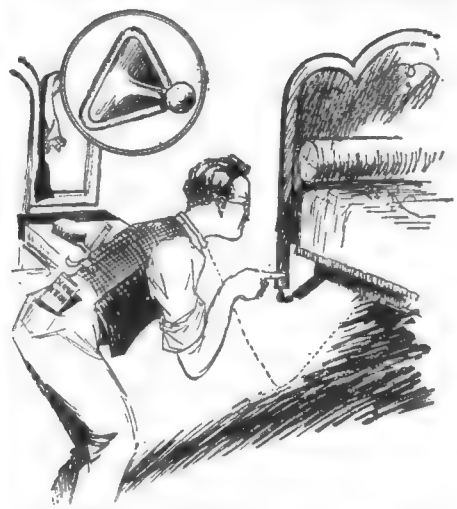
NOTE:—Before mailing your letter to this department, see to it that your name and address are upon the letter and envelope as well. Many letters are returned to us because either the name of the inquirer or his address is incorrectly given.

COLLAR BUTTONS

(862) N. S. Bogdon, Warren, Ohio, has designed some unique collar button ideas and wants our opinion on the idea.

A. 1. We do not believe that you can possibly secure a patent upon your collar stud and button improvement. Ideas very similar to these have already been protected and have been found on the market.

The main difficulty with a patent of this nature



Triangular shaped bases on collar buttons will not prevent their loss.

is that it loosens on one or the other side of the collar and then is lost very easily. This suggestion is likewise true of the clip device.

With regard to the button improvement, we would suggest that it is not so much the round end of the button which causes it to roll as relatively light construction. We are confident that a button as designed by you will on identically the same conditions roll or rather bounce just as far as the button with a round shank. If you place a button on the table and attempt to roll it, you will find that it describes but a small circle.

CROSSING GATE

(863) Sam Daivies, Newton, New Jersey, submits plans for a gate to be used at railroad crossings and asks our advice as to patenting and marketing it.

A. 1. Unless your system of automatic crossing gate is very ingenious and infallible in operation, working in both winter and summer months, we would strongly advise against patenting the same. There is little likelihood of its being accepted.

BOTTLE CAP

(864) Frank Bedich. Binghamton, New York, says he has a novel bottle cap which should be useful and asks our advice as to manufacturing the article before obtaining a patent upon it.

A. 1. It will be impossible to do anything with your bottle cap unless you patent the same, but we are of the opinion that you should have no difficulty in securing the necessary finances among your friends in order to obtain a patent.

We cannot give you any advice upon this bottle cap unless we have information concerning its construction.

SANITARY POWDER PUFF

(865) C. M. Woodward, Pasadena. Calif., submits a model of an individual sanitary powder puff. He asks our opinion on the proposition, stating that the idea is in the line of individual drinking cups, and is intended to eliminate the necessity of using a powder puff over and over again.

A. In our opinion your powder puff would find quite a ready market if the same were sold at 1c or 2c. We doubt very much if you can manufacture these to sell at this cost, as the device seems to be entirely too expensive. It would be advisable to decrease the size of the whole, which will incidentally cut down manufacturing costs. As a matter of fact, a small tuft of cotton with a gauze surrounding the same, containing the powder on the inside, and then faced with a sheet of paper, would serve the purpose just as well.

We would suggest that you have a patent-search made upon the idea, and if you find the device seems to be patentable, work along this line. We do not look upon your design with favor, and would suggest marked improvements in the same, to reduce not only manufacturing costs, but also the method of holding the powder, and the way of disposing of the puff after it has been used.

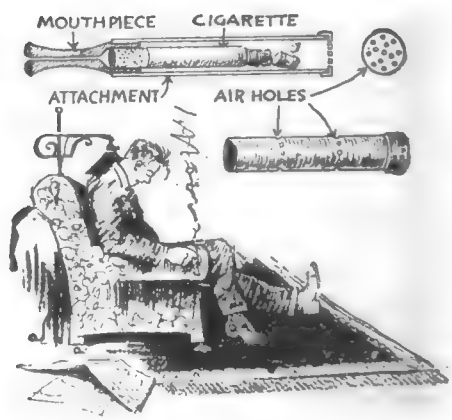
With your device there is a possibility of spilling the contents of the powder puff box, which was proved when the writer attempted to examine the model you sent.

ASHLESS CIGARETTE HOLDER

(866) H. P. Maher, Seattle, Wash., submits sketches of an ashless cigarette holder which he devised and on which he desires advice. A sketch of the holder is given herewith.

A. We are of the opinion that a device of this nature is not patentable, as hundreds of similar ones have been proposed from time to time. Furthermore, we do not believe that such a cigarette holder would be looked upon with favor by the smoking public. The inside of the holder would soon become soiled because of the action of the smoke and ashes and furthermore, the holes in the sides of the cigarette container would allow ashes to sift through. We would most certainly advise you not to invest any money in promoting this idea.

(*Continued on page* 932)



A cigarette holder such as shown above, is not patentable for the reasons given in the text.

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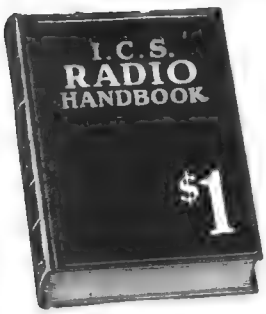

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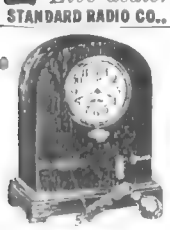

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The Living Death

(*Continued from page 934*)

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There is common-sense for you! And it is a great consolation to know that there is little likelihood the supply will ever fail us.

This celebrated powder, by the way, was simply pulverized ferric sulphate.

I remembered, too, that, when the first Ornithorhynchus was brought to Europe, those wise fellows the naturalists sat up and stared and then turned to common-sense for an explanation of the outré phenomenon before them, with this result: those wise old owls solemnly came to the conclusion that it was nothing but a clever hoax, that some joker had taken a duck's bill and stuck it onto the animal! Very clever, but he couldn't fool them!

Also, when they heard that someone somewhere in Africa had seen some kind of creature with a neck tremendously long, those same wise naturalists said they knew that *ex Africa semper aliquid novi,* for the ancients had so written, but—well—ahum, nothing so strange as often was to be found in the human encephalon, these strange things being known as illusions, hallucinations and delusions.

Not so very long ago common-sense prescribed the heart of the poor nightingale for those suffering from loss of memory, and for thousands of years, convinced mankind that the earth was flat as a pancake.

When Scheiner (to whom some attribute the discovery of the spots on the sun) informed the provincial of his order that the great luminary, the Eye of the Universe, was suffering from ophthalmia, this was the answer he received, dictated, of course, by our old friend common-sense:

"I have several times read my Aristotle all through from beginning to end, and I can assure you that he mentions not a syllable about it. Go, my son, tranquilize yourself, and be assured that what you suppose to be spots on the sun are nothing but specks in your eyes or flaws in your glasses."

It is easy enough to smile at this, at such blind submission to the authority of the great Stagirite—just as easy, in fact, as it is to forget that most of us, after all, are pretty good Aristotelians in more ways than one.

Your scientist is a great admirer of common-sense. Indeed, Huxley says somewhere that science is nothing but organized common-sense. Ahum, let us see what this common-sense really is. In former times, when a man spoke of stones falling down out of the sky, your scientist, this votary of common-sense, gave a smile of pity and said something about superstition and old wives' tales. It was not until the shower of meteoric stone at L'Aigle in Normandy, in 1803, that scientists realized that stones actually do fall from heaven. The French government sent Biot to investigate this old wives' tale that had come out of Normandy, and his report made it impossible for even the most devout worshiper of common-sense to doubt any longer.

And there you have it: up to the year 1803, common-sense declared the thing ab-

(*Continued on page 938*)

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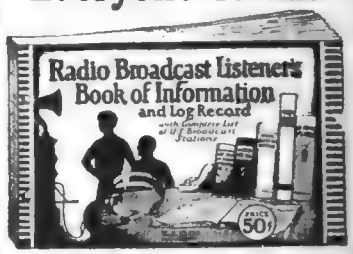

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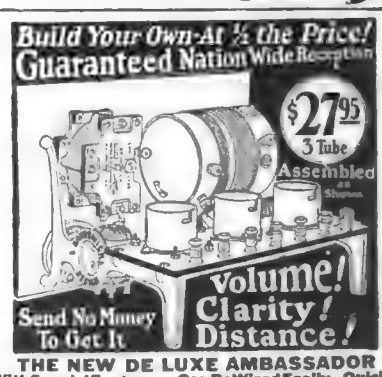

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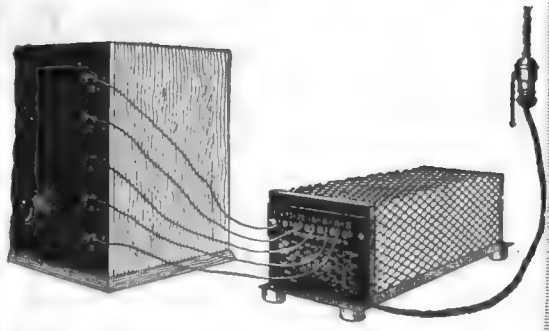

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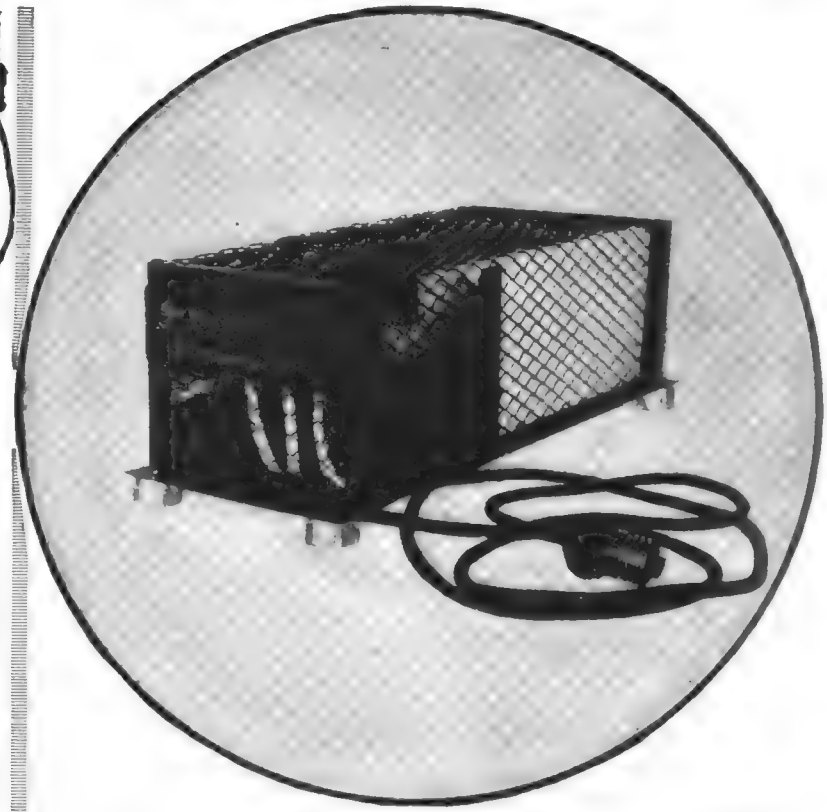

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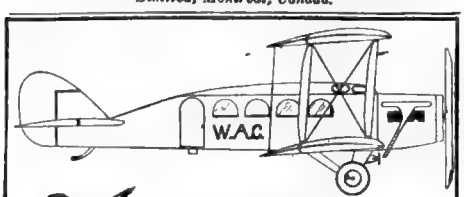

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The Living Death

(*Continued from page* 936)

surd and, ever since, that it is absurd to suppose it absurd. Can you beat it?

Well, I can.

Common-sense used to tell the scientist that, as a spherical body of incandescent gas loses heat, it must needs grow cooler and cooler, that the more heat it loses, the colder it must become; and then along came Lane and (quoting common-sense, who a moment before had said just the opposite) proved to that scientist that such a body, instead of growing cooler, in fact becomes hotter and hotter—that the more heat it loses, the hotter it gets!

What do you think about that?

We are told (by common-sense) that resistance retards the speed of a body. Of course. For once common-sense, we say, is right. But common-sense hasn't finished yet. For right around common-sense turns and informs us that, if a body traveling round the sun—a planet or a comet—encounters a resisting medium, its speed, instead of being retarded, is accelerated—that the more resistance such a body encounters, the faster it must go!

Can you beat that? I can.

Common-sense tells us that molten metal is very hot and that it will burn a man. Yet a man can thrust his hand into a stream of metal as it flows from the furnace and draw the hand out again without even a blister. I have seen it done. All that man did—it was Darwin Frontenac—before thrusting his hand into that molten stream, was to dip it into a pail of water.

So what, after all, is common-sense but a sort of psychic Great Mogul? And, like all moguls, g r e a t or s m a l l, he sometimes cuts some mighty queer capers. For instance, sometimes at midday he gravely remarks that it is midnight. And what do we do then? Do we try to show his majesty that, instead of being midnight, it is in reality noonday? Not we. For he is the Great Mogul—and we? We are worshiping subjects (alias Aristotelians) and we all exclaim, our voices raised to accents ecstatic:

"Behold the moon and the star!"

I thought of these things and of many more, and then the Captain broke the silence and my train (or jumble) of thought—for which, I have little doubt, you will be rather thankful.

"Yes," said he, "to awake her!"

He was gazing earnestly, wistfully at Darwin Frontenac. Frontenac's eyes were fixed on the other, the expression in them keen and yet strangely vacuous, but he did not break the silence.

"To awake her!" murmured Captain Stanley Livingstone. "Once I would have thought such an idea wild as the wildest fancy of poet or romancer; but now I believe that it is a sober possibility."

"It is," Frontenac nodded, a glitter in his gray eyes, "if the girl's condition be indeed one of suspended animation, if life had not quitted the body before it was frozen."

"I believe, Mr. Frontenac, that it had not, that Hampden was right, that my poor Sleeping Beauty is in that strange state which is neither life nor death."

"It is very possible," Frontenac said. "But one can't be sure of that until——"

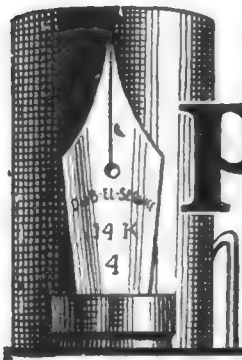
"Until?" queried the Captain, leaning forward.

"One can't be sure, Captain. Remember, the girl had been drugged."

"I remember that, Mr. Frontenac. But she isn't dead; she can't be dead! A dead body could never be so lifelike in appearance."

Frontenac made no response.

"There is one thing, though," said the discoverer: "suppose that the drug they gave



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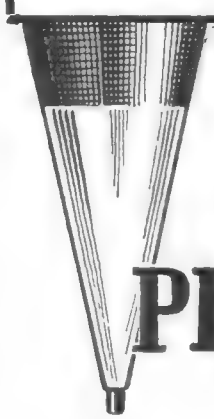

The PENCIL

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her would have proved fatal if the cold had not fallen; in that case, if you awake her, will the poison continue its work and kill her, kill her after all these thousands of years?"

"No," Frontenac answered: "my antidote will neutralize the belladonna, mandragora or whatever it was they gave her—if I can awake her!"

"Then, Mr. Frontenac," the other exclaimed, "you are going to go down there and get her?"

Frontenac smiled a little.

"Exploring, Captain, is rather out of my line."

The other waved a hand airily.

"Don't hesitate a moment because of that. Did you learn to swim before ever you went into the water? Never fear, Mr. Frontenac, you will be an explorer before you get back."

"If I ever do!"

"You will get back to the world. You'll go down there better prepared than I was. You'll know what you are going to meet."

"I'm afraid that I don't. All I know is that it is a thing with an enormous claw."

"Oh, well," said the Captain, "you know that it is *there*, which is more than I did.

"And," he added, "as for experience, I understand that you have been in the Arctic."

Frontenac waved a hand deprecatingly.

"I was never very far from the ship. I was only a scientist, not an explorer, though I may truly say that it would have been the other way around if my own wishes could have been followed."

"And I," said the Captain, "am only an explorer, not a scientist. Experience, Mr. Frontenac, is, of course, a great thing, but not so great as it is often held up to be. It isn't everything, by any means. And, besides, experience is very apt to put a man into a rut. He is often sure, certain, absolutely positive that this thing can be done and that that thing can't when, as a matter of fact, he doesn't know anything about it at all. That's the one bad thing about experience. It is the new men, as a rule, who do the new things."

"I have long believed that. But here is another thing: I have my work here to do; nothing has been farther from my mind than that I should ever go forth as an explorer. And another thing, Captain: I am no longer young."

The Captain stared, then a smile moved those weather-beaten features.

"You are not yet old, by a good many years."

"Alas, I am; I'll soon be forty."

"Forty!"

Captain Livingstone laughed.

"Now," said Frontenac, "if I were as young as my friend McQuestion here, if I were (as he is) a regular, genuine, dyed-in-the-wool, blown-in-the-glass sourdough, a member of the great Order of Icicle Muckymucks as well as that of the Muckluck Tillicums, if I could live for a whole week on a snowflake and simply feast upon a rabbit-track—if all that were only so, I wouldn't hesitate for a single moment. But, as it is——"

"As it is?" the Captain suggested.

"As it is, not being qualified to become an Icicle Muckymuck, to say nothing of a Muckluck Tillicum, what can I do?"

"Well, Mr. Frontenac," the explorer smiled, "your moment is up."

He turned his look to me.

"Are you going to go with him, Mr. McQuestion?"

"*Is* he going?"

The Captain turned his look back to Darwin Frontenac.

For some moments there was a deep silence, then Frontenac spoke:

"Yes, I will go, Captain Livingstone; I will get your Sleeping Beauty and awake her if I can—if that thing there in the Gardens of Paradise doesn't get me within the reach of its claws."

(*To be continued.*)

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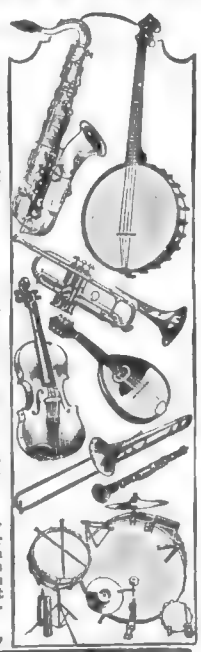

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Reader's Forum

(*Continued from page 905*)

the brain for that is flesh or physical and mind is not physical but spiritual. Mind has the power of memory, to think, speak and send orders through the body. But when mind is separate from the body then it just has memory, thought and speech, which is spirit. *I am told of things that are to happen and they have happened or taken place just as they were told to me. (Italics ours.—Ed.)* I can relate a good many things at different times that actually happened and that were told me beforehand. The above statements are all true.

MRS. EDYTH BISHOP,
Grizzly Flats, Calif.

(SCIENCE AND INVENTION *Magazine does not believe in Spiritualism and one of the awards in the* $11,000.00 *contest for the production of Spiritual phenomena is:*

$1,000.00 will be paid to any person who will accurately describe something definite going on at a distance in a place selected by Mr. Joseph F. Rinn, or who will predict in advance an event or calamity of such a definite nature that it would be impossible for such person to have any controlling power over or previous knowledge of the same.

If, therefore, you are positive that you are capable of foretelling an event which will come under the above prize heading, the editors would suggest that you enter the Spiritualistic contest. It may be mentioned in passing that not one worth-while phenomenon, not one Spiritual manifestation has been produced which was not obviously on its very face fraudulent and which the perpetrators did not admit when they were cross examined. Each and every one of those who attempted to demonstrate Spiritual phenomenon, therefore, have admitted that they were practicing deceit and fraud in an attempt to recover all or part of the $11,000.00 *offered by* SCIENCE AND INVENTION *Magazine. We dare to say without fear of contradiction that there is no one capable of producing genuine Spiritual phenomena. In New York City Spiritualists must practice under cover if at all. In California, on the other hand, palmists, clairvoyants and Spiritual advisers of all kinds fill the columns of the newspapers with their advertisements.*

We often wonder why the response to this contest is no greater than it has been and why we are not overwhelmed with applicants for the awards. Can it be that all professional Spiritualists know that they are practicing deceit? This same question does not apply to private parties who became so enthused with Spiritualism that they permit their subconscious mind to dictate messages seemingly from the dead.—Editor.)

A BOOST FOR RAY CUMMINGS

Editor, *Science and Invention:*

I am writing at this time to inform you of the great interest I took in reading the serial story, "The Man on the Meteor." I waited for each issue of the magazine wondering what would happen next. Every part of the story was very vivid and full of action. Could you inform me as to who "Nemo" is? I would very much like to get the story in book form. Do you think it will be printed this way soon?

HARRY PROSS,
Bristol, Conn.

(*Nemo—the "Man on the Meteor,"* is purely a *fictitious character. We understand that this story is to be published in book form at an early future date.—Editor.*)

PERPETUAL MOTION

Editor, *Science and Invention:*

Your letter in regard to perpetual motion machine just received. I note you ask for working model to be submitted in your perpetual motion contest.

When I wrote you I had been assured by my attorney at Washington that he had looked over the records and found nothing to conflict with my claim and that I had a wonderful proposition. But since he has made further examination of records and informs me that some person has been granted two patents covering every claim I had out forth. Now that being the case see no incentive in getting out a model unless it would be to get your $1.000.00 prize.

I feel confident that the machine will work, because the operation of the 24 pumps in no way retards the operating of the wheel or it requires no more power to revolve the wheel when pumping than when pumps are not pumping.

I got my idea from an exhibit of frictionless ball-bearing on exhibition at the Gottenberg, Sweden, Exposition. They run a 10-ton flywheel mounted on these bearings, using a No. 10 spool cotton thread for belt and small sewing machine electric motor for power, that being the case I feel confident that a one horsepower motor would operate my 30-ton wheel and compress about 8 cu. ft. of air per minute, which is a record I believe.

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And since the Patent Office has granted two patents on this same machine, without model, then I should think that your publication would be glad to accept my drawings for competition for your prizes, especially since I never really claimed perpetual motion for my machine.

LOUIS H. CORDIS,
Astoria, Oregon.

(Unfortunately the editors cannot consider drawings as perpetual motion prize entries. SCIENCE AND INVENTION holds that a perpetual motion machine was never made. Many inventors are equally positive that they have invented the system and can demonstrate it.

SCIENCE AND INVENTION says, "Show Me." And for being shown we offer $1,000.00 to anyone who will but merely demonstrate a working model. No patent for a perpetual motion machine, as such, has been granted by the Patent Office during recent years. Several patents for perpetual motion have been granted by the Patent Office under the heading of "Energy Transmitting Devices" and as "Toys." All of them mention a motor "in order to start the device." This gets by at the U. S. Patent Office if the above quoted statement is made and perpetual motion is not claimed.—Editor.)

SUN POWER

Editor, *Science and Invention:*

I read and enjoy your magazine quite often, and have just read the September issue. *The Readers' Forum* interested me very much, especially the letters relative to heat and electricity from our sun. Mr. Templin's article was enough to make one sit up and take notice.

Since you invite letters along this line, and while my Genius calls me (as my favorite author, Emerson, puts it) I will write.

This talk about heat, etc., from the sun, brings to me an idea which like Banquo's ghost will not stay down. I often think about it, but that is as far as it has ever gone except an occasional discussion with some semi-amateur astronomer friend. The idea is to store up in some manner the heat we are always trying to get rid of in summer and use it in winter.

To my mind this would be the greatest boon science could bestow on man, as he is at present constituted, provided, of course, that some monеyed shark did not get hold of it and tie it up so that he, his heirs, assigns and legal representatives would have a perpetual monopoly, and then breed parasites for the rest of mankind to support.

The idea does not fall in the same category (at least to my mind) with perpetual motion, for it would not be a case of trying to get something for nothing as in perpetual motion, but simply "holding fast to what is good," i.e., something we already have.

The idea of course could not be new, but I would like to know what others and better minds have thought of it, and what if anything has been done, or is being done towards the solution of the problem. What is your idea?

A. E. STEWART,
Charlotte, N. C.

(Attempts have been made to store only a slight part of the energy of the sun in several ways. Water power is one of them and production of electricity by means of two copper sheets, one of which is oxidized and the other polished, immersed in an electrolyte, is another method.

In California and in Africa power plants in the form of steam engines are in operation. Here the energy for the heat of the engine is developed by the sun and is concentrated by reflectors.

All of this does not even scrape the surface of the field and we may look forward to even greater systems of utilizing this power of the ages.—Editor.)

A SPIRITUALIST

Editor, *Science and Invention:*

Some time ago I witnessed one McAlbert read some 200 names and questions from a large crystal. Of course, he called it "spiritualism."

Has there ever been an explanation given for this stunt? If so, where was it printed?

He had a confederate. Questions and names were placed on small slips of paper. Then he would lecture for an hour, go into a room where his confederate had been, get a large crystal, place it on a handkerchief, and read names, questions and answers (?) with startling rapidity. Approximately 200 questions were answered. Could globes be so constructed to expose to his view all this information or was this information held in his hand?

J. R. PELSMA,
Pittsburg, Kansas.

(McAlbert is a legitimate performer and consequently we will not expose his system. If he claims that his trick was spiritualism we should expose him. Nevertheless, he does not attempt to defraud the public and is acting, purely for entertainment. For that reason, we will say that what he does is not spiritualism, it is just a plain trick known to every magician. An improvement of this trick was described by Professor Dunninger in the columns of this magazine in one of his early articles.—Editor.)

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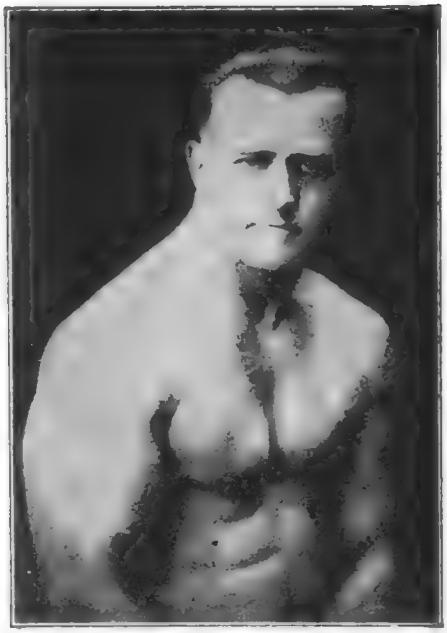

EARLE E. LIEDERMAN
The Muscle Builder

"THOU SHALT NOT KILL"

is the most gruesome commandment handed down to mankind. A man may lie, steal or break any other law and the public will eventually forgive and forget. But let him commit murder and the cry of everybody is to give him the full penalty —*Death!* And what is the common excuse of the murderer? INSANITY! Sure, he's crazy. Any man must be crazy to commit murder.

But how about the fellow who slowly but surely kills his own body by neglect? He's the craziest one of all.

Stop! Think this over! What are you doing with your own body? Surely you don't want to be put in this class. But if you are not doing everything possible to prolong your life and keep your body just as clean and healthy as your Maker intended, you are inviting death. You are slowly but surely killing yourself.

A NEW LIFE

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TODAY IS YOUR DAY

This is your birthday. Today you start a new life. I'm going to make a real live, "rip-snortin", go-getter out of you. I'm going to expand that chest so it will give your lungs a treat with life-giving oxygen. This will put real vim into your blood and shoot it throughout your entire system. I'm going to broaden your shoulders and strengthen your back. I'm going to put a ripple of muscle up and down your body that will make a big powerful he-man out of you. You will have the arms and legs of a modern Hercules. I'll clear your brain and pep up your entire system. You will be just bubbling over with vitality. You will stretch out your powerful body and shout for bigger and greater things to accomplish. Nothing will be too difficult for you to tackle.

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Book Review

THE PEOPLE'S INSTITUTE EXTENSION COURSES. PSYCHOLOGY.

We have received from The People's Institute Publishing Company, a series of pamphlets, six in number, on Psychology. It seems that Dr. Charles Beard once said to a friend, "If I can only gear my lectures to a battery of linotype machines." With all due regard to the Doctor's mechanical abilities, we would observe that one linotype machine might answer every purpose. The People's Institute Publishing Co. has now undertaken to issue in pamphlet form stenographic transcriptions of the lectures of prominent scholars, which before publication are edited by the lecturer. Week by week they are published, and they establish a correspondence course, in the sense that a person receiving these lectures can ask questions regarding the lecture by mail, and will receive replies from the lecturer. Lesson sheets are also given to direct the student in his work. We are glad to see that the managers of this interesting course in psychology emphasize the existence of quacks and sensationalists who disseminate pseudo-psychology. The idea of the Company is to give prominent lecturers very wide publicity by printing their lectures.

THE MECHANICAL PROPERTIES OF FLUIDS. A Collective Work. Hard covers, 6" x 8¾", profusely illustrated. Published by D. Van Nostrand Co., New York City. Price $6.00.

The D. Van Nostrand Company are the American publishers of this collection of essays on the mechanics of fluids. The book is largely mathematical, but brings in enough literature to make it really good reading. It is made quite practical too by the treatment of such subjects as submarine signaling, the reaction of air on artillery projectiles, the use of soap films for determination of liquid stress, directional listening, so as to determine the locality of a steam whistle or cannon shots, and lubrication even is brought in. The reviewer has turned with some fear to the end of the work to see if it is indexed, and is gratified to find two indexes there, one of the subjects and one of the names. As an instance of the practical aspect of the book, we would cite the short description of illustrations of the Venturi Meter, and Pitot Tube. There are nine authors.

THE EINSTEIN THEORY OF RELATIVITY. By Garrett P. Serviss. Hard covers, 5" x 7½", profusely illustrated, 96 pages. Published by Edwin Miles Fadman, Inc., New York City.

The preface of this book states that the Einstein theory has reached a celebrity which makes it essential for everybody to know something about it. One of the blessings of humanity is that nobody has to know all about it, and the illustrious twelve who are supposed to be the only ones who do understand it are certainly to be congratulated upon the depths of their intellectual powers. Up to a certain point, relativity is absolutely simple, but when we come to what we may term the "Einstein Relativity," it certainly is a test of the understanding. This book is based largely on the Einstein film, prepared for moving picture projection, and the illustrations are naturally very attractive and Mr. Serviss seems to have done very well in making an agreeable text on so obstruse a theory. As an instance of relativity, some pictures are given to show that one rock may be large or small in relativity to the other. It certainly does not need the Einstein Theory to tell us that.

THE MATHEMATICAL THEORY OF RELATIVITY. By A. Kopff. Hard covers 5" x 7¼", 214 pages. Published by E. P. Dutton & Co., New York City. Price $3.20.

From far off Heidelberg comes this mathematical treatise and the book is absolutely beyond review. The formulas are simply blinding in their extent. It would be quite interesting to know whether Prof. Kopff is one of the great twelve. It is often a subject of surmise how far a difficult differential equation or formula operates to convince the mind, even of the mathematical reader. The Einstein theory is peculiar in one respect. It has the good fortune to be eagerly accepted by many, who cannot follow its mathematical developments.

The publishers call this work "an elementary introduction" to the theory. If this book is elementary what must the full treatises be? These last words of the book may be a comfort to the layman, "it still lies with the future to bring about full and complete agreement between theory and experience."

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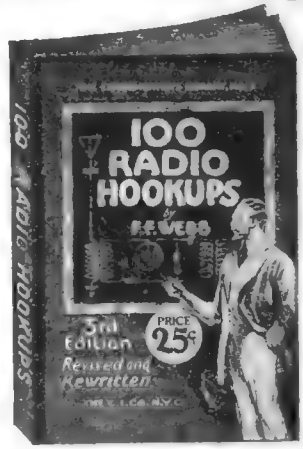

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MAKERS OF SCIENCE. By Ivor B. Hart. Cloth, 320 pages. Published by the Oxford University Press, London.

Very few histories of science are written in such a manner as to maintain a connected thread of narrative throughout the book. A great many others lack a sufficient amount of detail on the author's life which in many cases throws important sidelights on the discoveries of the scientists, aside from adding greatly to the romance of the complete work.

This little volume deals rather completely—at least as concerns all the major discoveries in the realm of science—with the constant growth of scientific knowledge, from the time of the early Greek philosophers and mathematicians down to the present. Science as used here, of course, means exact science.

Along with the thread of a narrative showing the constant additions to the sum of our scientific facts, there is the life story of the various men whose minds gave these facts to the world. Most of the discoveries are given simply with the laws and axioms which were postulated by their discovery. Not the least interesting feature of this little volume is, as has been said before, the biographical details of the life of the discoverer of the various facts. Although the name of the volume would seem to indicate that it was merely a collection of disconnected papers upon important scientists, quite the contrary is true, since the whole thing contains a more or less continuous narrative.

It is one of the most interesting scientific volumes dealing primarily with the more theoretical side of the question that has come to this department's view in some time. It is most interesting.

A THOUSAND AND ONE FORMULAS. By S. Gernsback. Cloth, 160 pages. Published by Experimenter Publishing Co., New York. Price $1.75.

How many times has the experimenter been confronted with the problem of finishing a metal cabinet, needing some particular kind of glue or being in a hole for lack of some peculiar cement! This little volume is designed primarily to take just such causes of grief from the life of the experimenter. It is divided into a number of main divisions each of which contain subject matter dealing with a certain sub-division of the experimenter's work. Suggestive headings are: Cements, glass and glass working, inks, metal-craft, photography, electroplating, pyrotechny, varnishes and paints, and even perfumery and soaps.

One of the most interesting divisions of this volume is that which is placed at the conclusion of the formulas, and which deals with laboratory hints, designed also to elucidate a number of points usually found baffling to the laboratory operator. The method used in writing this book makes it extremely valuable as a reference work. Values and compositions are set out in the simplest possible terms, while at the same time, due importance is given to the method in which the substances given in formulas must be prepared. This latter point is one which is frequently overlooked in such works. The book is extremely well indexed.

THE CONCRETE ENGINEER'S HANDBOOK. Edited by the staff of the International Correspondence Schools. Cloth covered 3½" x 5½", profusely illustrated, 368 pages. Published by the International Textbook Co., Scranton, Pa. Price $1.00.

This extremely valuable little pocket reference manual on concrete engineering contains a valuable set of weight and measure tables in the forepart, and describes clearly and simply how to measure various surfaces of triangular and other shapes; this is followed by a concise and easily understood section covering the calculations for various loads on structures. This section contains several extensive tables containing the weight of various materials, including farm products, coal and wood. Some necessary laws of mechanics are then discussed with simple formulas, and this is followed by several pages on stresses and strains. A valuable treatment with elaborate tables is then given on homogeneous beams. This is followed by a chapter on sand and cement; tests of cement; mixing and working of concrete with a handy table giving the proportion of ingredients and quantities to be mixed for various concretes.

A clear and very well illustrated section deals with steel reinforcements of concrete structures, and then we come to a chapter on concrete design. One of the closing sections takes up the design of foundations, including cantilever foundations, and the final chapters deal with building details, form work, water-proofing and building laws.

PLUMBERS AND FITTERS HANDBOOK. By the staff of the International Correspondence Schools. Cloth covers. 3½" x 5½", profusely illustrated, 376 pages. Published by the International Textbook Co., Scranton, Pa. Price $1.00.

This excellent little handbook will find wide use in the hands of plumbers, heating and ventilating experts, and all those who are interested in this

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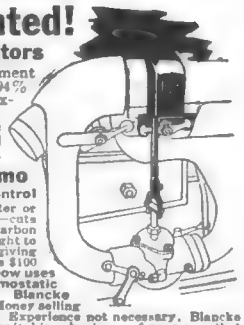

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class of work. The book has a very thorough index like others of the handbooks put out by the above institution. The forepart deals with weights and measures, and the calculation of areas, together with tables of the circumferences and areas of various sized circles. Among the subjects covered in this well edited treatise are tin roofing; properties of air and steam; ventilation; loss of heat from buildings; fuels; chimneys; size of hot air pipes and stacks as well as registers, etc. Another section takes up heating by steam, and the mechanical details connected therewith. This is followed by a chapter on hot water heating, a system which is now so much in vogue in private homes and other buildings, and we then read about blower systems of heating. The air supply of public buildings, heating and ventilation is well discussed, with valuable tables and formulae. Gas and gas fitting is then treated on, and the book ends with a well illustrated and clearly discussed section on plumbing, including bathrooms, kitchen boilers, sprinkler systems, etc.

RADIO FOR EVERYBODY. By Austin C. Lescarboura, 361 pages, cloth covers, 7¼ x 5¼", illustrated, price $1.50. published by the Scientific American Publishing Co., New York City.

The author of this work has taken a preceding book of the same title as given above and rewritten it, enlarging and revising many portions of it, so that it is thoroughly up-to-date. Even with the many radio books that we find on the market today, this one has its place. It is in itself a complete text book on radio reception and covers practically every phase of the subject in a clear and concise manner. All of the latest improvements in radio frequency transformers are discussed and illustrated in detail. Even the sodion tube, a comparatively recent addition to the radio family, is described and discussed.

A complete chapter is devoted to the discussion of many different types of standard radio receivers, ranging from the simple single tube sets to the second harmonic six tube super-heterodyne receivers and the popular combinations of a radio set and phonograph.

One of the last chapters in the book is devoted to circuits and their explanation. Not many circuits are given, but each and every one is of a fundamental type and tends to keep confusion at a minimum. The book is at least on a par with any of the radio books found on the market today, and far better than many of them.

AUTOMOBILE IDENTIFICATION. By Sergt. John F. Brennan, 176 pages, hard covers, illustrated, 7½ x 5", price $2.50, published by Scientific American Publishing Co., New York City.

The identification of automobiles by sight is an extremely important subject to the police and makes an interesting study for the civilian. The author of this book is an instructor in automobile identification in the police department of the city of New York and therefore is well qualified to speak on the subject. By means of a system of key numbers, the various different types of automobiles are classified. First, styles of bodies are illustrated and then particular makes of cars. Each one of the latter is shown in a clear halftone cut which depicts the appearance of the car very clearly. In each case, some particular feature of the car, a feature which stands out above all others, is noted. Therefore, identification becomes easy, comparatively, after a study of the illustrations. Then follow a series of illustrations of radiators of different kinds.

Bumpers and hub caps come in for their share in the identification process and many different styles are shown. Brakes are discussed and a few pages are devoted to safety measures.

This book is one which should be of interest to every automobile owner as it gives the police viewpoint of the automobile situation. It shows how the police are attempting to co-operate for the prevention of theft and accidents and gives several striking examples of ingenious detective work on their part. The book is one which makes interesting and instructive reading to any one connected in any way with automobiling.

INVENTOR'S MANUAL. By George M. Hopkins, 128 pages, 7½ x 5", cloth covers, price $1.50. published by the Norman W. Henley Publishing Co., New York City.

Although a small book in size this manual for inventors contains a wealth of information which is of great value to those to whom it is addressed. The book is designed principally to give a few hints toward the patenting of original devices and other hints which will enable an inventor to steer clear of the many swindlers who may try to cheat him out of his invention or who may try to separate him from some of his money by many different methods. The various money-making schemes are outlined and the inventor amply warned. The method of obtaining a patent is clearly outlined. The author then goes on to tell how newly invented devices can be placed on the market and deals with the obstacles that are to be met in trying to market any device.

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RADIO WRINKLES

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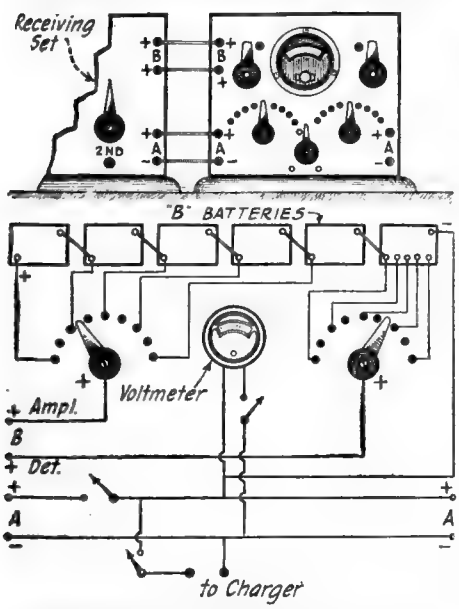
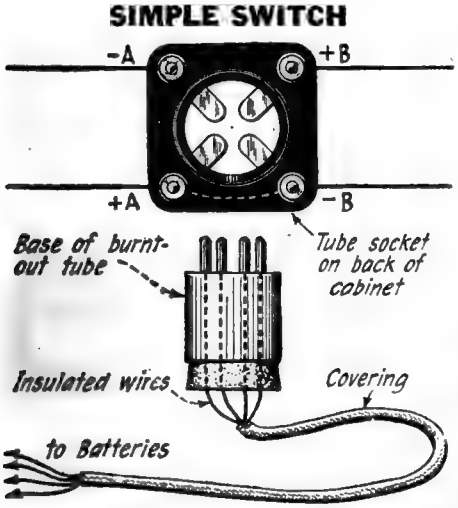
BATTERY CONTROL PANEL



By placing the "B" batteries within a cabinet and employing the circuit given herewith, a very handy and helpful arrangement is provided, which protects them from dust, short-circuit and breakage. The "A" battery connections are also incorporated on the panel and thus lends itself to ready recharge. A 0-10-voltmeter presents an attractive appearance and is very useful in testing the "A" battery. —Evermont Fisel.

SIMPLE SWITCH



The obvious advantages of using the above switch speaks well for it. The base of a broken tube is employed and fitted with a large cork. Both "A" and "B" battery connections are made and insured against accidental run-downs, shorts, etc.

—Alexander Horsfall.

NEIGHBORS

When Ephraim Crosby made a clearing far out on Valley Road and built his house, he had no neighbors. He lived an independent life, producing on the farm practically all that his family ate and wore. Emergencies—sickness and fire and protection of his homestead from prowlers—he met for himself. Later he had neighbors, one five and another eight miles away. Sometimes he helped them with their planting and harvesting, and they helped him in turn. Produce was marketed in the town, twenty miles along the cart-road.

Today Ephraim Crosby's grandchildren still live in the homestead, farming its many acres. The next house is a good mile away. But the Crosbys of today are not isolated. They neighbor with a nation. They buy and sell in the far city as well as in the county-seat. They have at their call the assistance and services of men in Chicago or New York, as well as men on the next farm.

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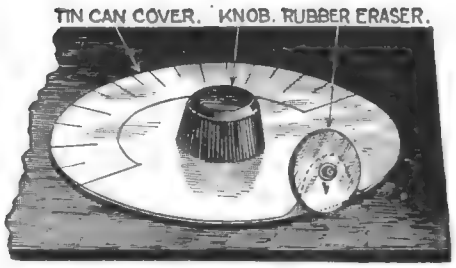
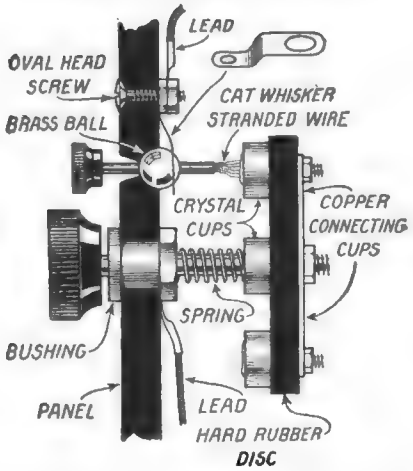
TIN CAN COVER DIAL



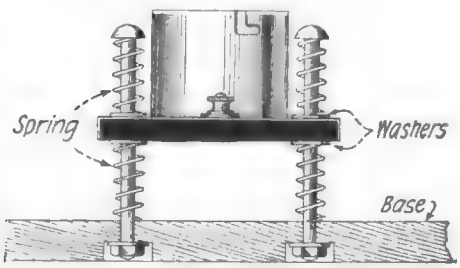
The cover of a tin can be salvaged and utilized as a handy dial. It is fitted with a rotary eraser which acts as a vernier, and is calibrated in the usual manner.
—E. R. Gilmore.

MULTIPLE DETECTOR



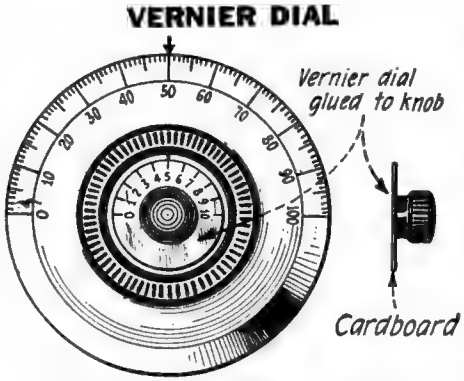
Very often the sensitive spots on a crystal are lost and when in necessity, it is usual that they cannot be found. By building one of these multiple crystal holders, it is possible to revert instantaneously to a sensitive crystal. The drawing clearly shows its construction, four cups being mounted on a circular bakelite or hard rubber disk. —F. J. Bruno.

SOCKET SUSPENSION



A non-microphonic socket mounting is made simply by following the above suggestion. Four short brass wire springs are placed as is shown and alleviate noise to a great extent.
—J. Futterman.

VERNIER DIAL



If a small cardboard dial is glued to the vernier knob of a condenser, accurate calibration of wave-length can be obtained. A white marker is scratched on the knob of the large dial. —R. H. Watkins.

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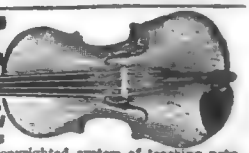

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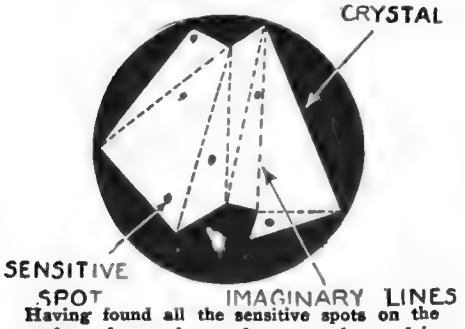
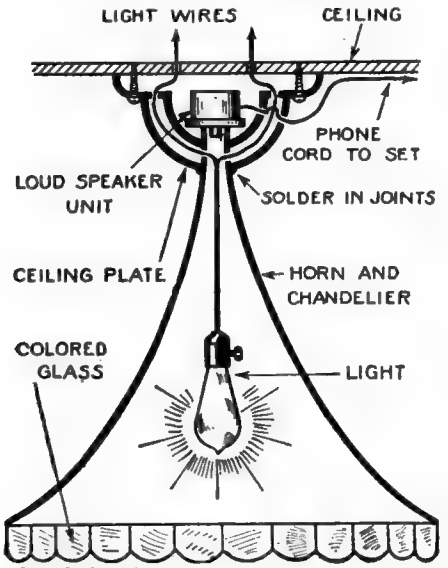


Having found all the sensitive spots on the surface of a good crystal, an actual record in the shape of a plan will help materially, when in a hurry. The surface is divided into triangles and all sensitive spots plotted.

—K. Liu.

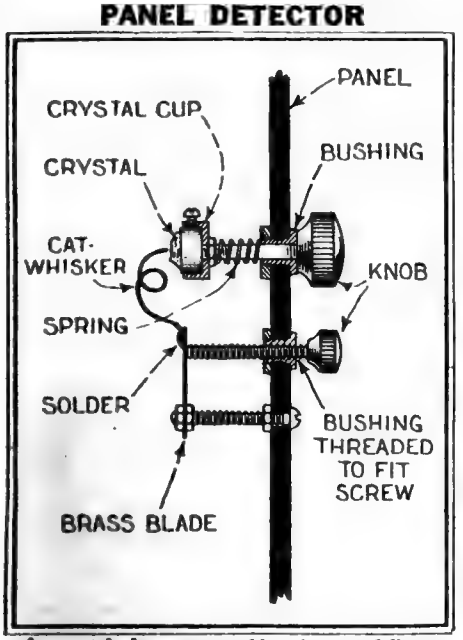
RADIO CHANDELIER



By placing the reproducer unit in the canopy of a fixture of the type shown, an exceptionally good loud speaker arrangement is had. Else, the horn of the loud speaker is adorned with a few embellishments and fastened as is depicted. This presents a very pleasing appearance, besides being practical.

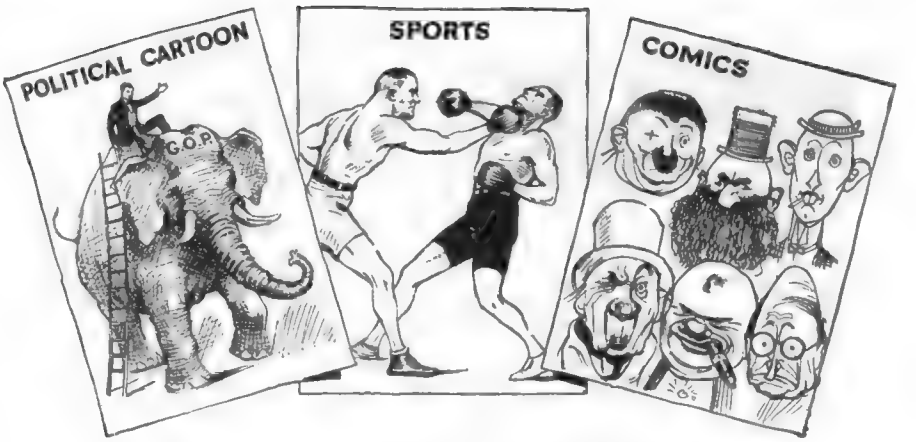
—Donald Crow.

PANEL DETECTOR



A crystal detector capable of very delicate adjustment is constructed as shown and affords neatness in appearance. The crystal cup is soldered to a short length of brass bar to which a knob is attached at the other end. A spring placed on this keeps the crystal rigid, while a vernier arrangement allows extremely fine adjustment.

—Samuel M. Mallin.



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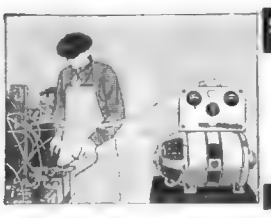

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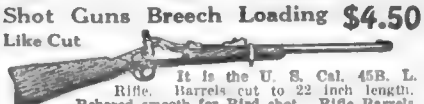

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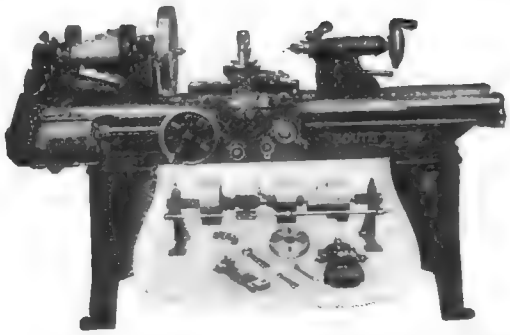

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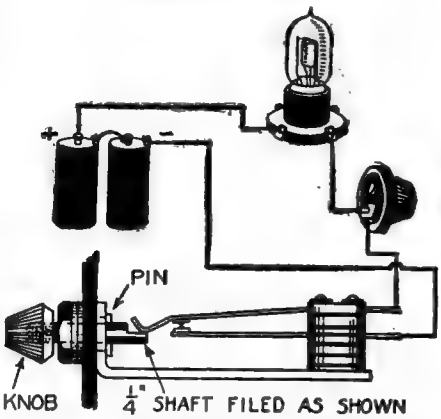
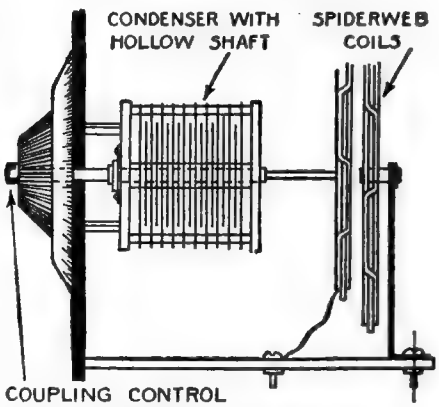
JACK SWITCH



A cheap as well as efficient filament switch can be made by utilizing an ordinary single circuit jack which is fitted with a short length of brass rod filed at one end and fitted with a small knob at the other. Two small pins running through it prevent it from working loose. In this way the different functions of a more complicated circuit may be readily controlled, positive contact being established at all times. —Halbert H. Clark.

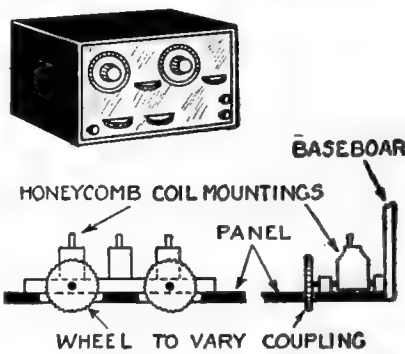
DUPLEX TUNING UNIT



For those building a portable set, this idea will go very well. The vernier plate from a condenser is removed and in its stead is attached a spider-web coil. The inner rod is thus made to vary the coupling between the coils of the receiving set. As can be understood, this arrangement allows of compactness to a greater extent than can be achieved by any other means. Flexible leads are connected to the movable part and terminate in binding posts on the base.

—George E. Johnson.

TANGENTIAL CONTROL



By attaching a honeycomb coil mounting on the back of a panel and equipping it with small wheels such as of bakelite or the ordinary typewriter eraser, a method for varying the coupling between the honeycomb coils is the result. Rheostats can be equipped in a similar manner and present a very pleasing appearance. The slots in the panel to accompany these controls are best cut by drilling a series of holes of the required diameter and using a file to finish up. —E. M. Abbott.

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Answers to Scientific Problems

(*Continued from page* 896)

THE SPOOL AND PLANE

The spool will evidently roll uphill or downhill depending upon which motion tends to lower the weight W. Suppose the spool drops (or rises) a vertical distance H while rolling a distance C equal to the circumference of the rim. In so moving it will roll up (or unroll) a length of cord equal to the circumference c of the drum. If the height H of the plane is less than the circumference c of the drum it is evident that the spool will roll uphill since in only that event would the weight descend. But if the height H is greater than the circumference c the spool will move down hill. On considering the similar triangles OBD and EFG it can be seen that H/ = OB/OD, and OB/OD is greater than r/R and therefore greater than c/C. Hence H/C is greater than c/C and H is greater than c. Therefore the spool will roll down hill.

Perhaps a simpler way to arrive at the same conclusion is to consider the action of the force W with reference to the pivotal point A where the spool comes in contact with the plane. The line of action of this force BDC passes the plane somewhat below A. Hence it will tend to turn the spool downward. If the line BDH passed through the plane above A it would tend to turn the spool upward while if it passed through A itself the weight would have no tendency to turn the spool either way.

THE GEOGRAPHICAL CENTER

The geographical center of a country may be determined by pasting a map of the country on a piece of pasteboard and cutting around the border. Then suspend it from a pin thrust through one corner into a wall. If the map hangs freely the geographical center will lie along a line drawn vertically downward from the pin. By changing the point of suspension to another corner a second line can be determined which passes through the geographical center. Then since the geographical center lies along both lines it must lie at their intersection. For the United States this point is not far from Junction City, Kansas, but probably somewhat further west.

THE ELECTRICAL CIRCUIT AND THE PLATFORM BALANCE

By means of a compass needle it can be readily shown that a magnetic field surrounds a wire carrying an electric current. The reaction of this field with that of the earth tends to make a wire move at right angles to the earth's field. It can also be shown that if the thumb, forefinger, and middle finger of the left hand be extended at right angles to each other with the forefinger in the direction of the magnetic field (earth's), middle finger in the direction of the current the thumb will point in the direction in which the conductor will tend to move. Applying this rule it will be seen that the force is downward on the platform B and upward on the wire on the platform A. Hence weights would have to be applied to platform A to secure an exact balance. The unbalancing force would be slight in the problem here given—about half a gram for most places in the United States, depending upon the strength of the horizontal component of the earth's magnetic field.

MOISTURE ON A FLAT-IRON

Water is one of the combustion products of illuminating gas. Ordinarily the water passes away unnoticed in the form of vapor, but when a cold surface such as that of a flatiron is present some of the moisture may condense in small droplets.

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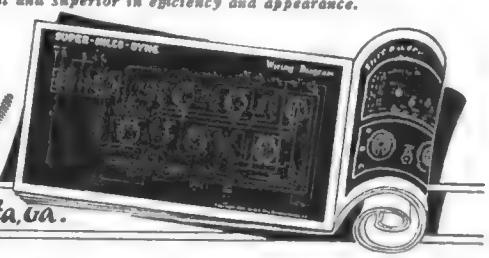

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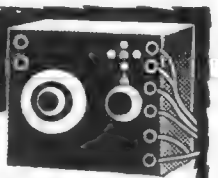

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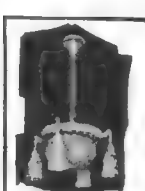

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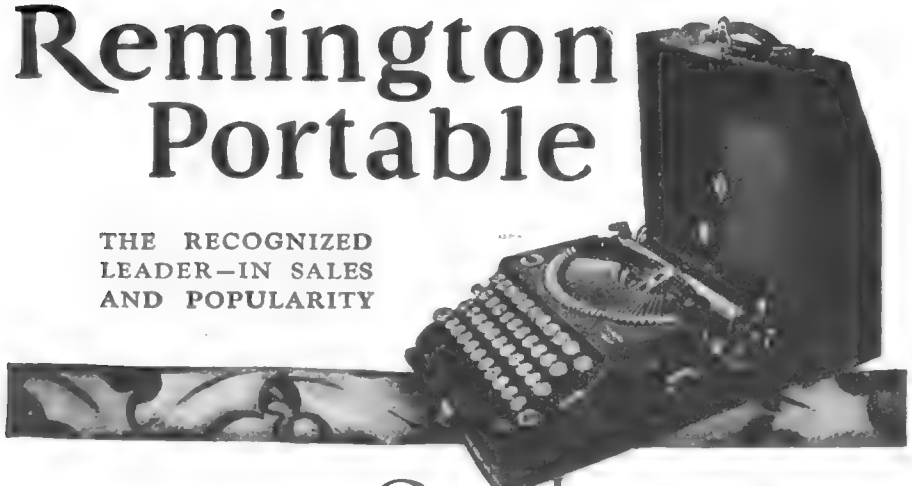

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THE STINGING OF A BALL BAT

If in swinging an athlete's hammer preparatory to a throw the wire should strike some obstacle it is very evident that the inertia of the hammer would cause it to give a violent jerk to the hands. Similarly in swinging a ball bat the behavior is much the same as if its entire mass were concentrated in one spot (the center of percussion) and whirled about a pivotal point like a hammer about the hands of the thrower. If a ball strikes squarely on the center of percussion the bat is merely retarded in its swing and scarcely any force is applied to the hands. But if it strikes at any other spot the reaction tends to turn the bat about some point other than its normal pivot and hence jars the hands more or less painfully.

THE PAPER SAW

Centrifugal force tends to keep the paper stiff and straight, and if the disk is whirled rapidly it becomes virtually quite rigid.

ACCELERATION AND WEIGHT

As the weight W descends it will move faster and faster, *i.e.*, accelerate, because of the constant net force equal to W—w acting upon the system. The effect is just the same then as if one were pulling up a small weight w and dropping a large weight W. Pulling up a mass with acceleration would increase the force on the arm of the lever, while dropping a mass would tend to decrease the force. But since the decrease is more than the increase it is apparent that the drawscales supporting the system will show a force, which will be less when the weights are moving than when they are stationary.

THE BULLET AND THE PANE OF GLASS

A fast moving bullet may pierce a sheet of glass so quickly that it actually doesn't have time to shatter before the bullet is through and on its way again. Such a bullet will leave a hole nearly as smooth as if it had been drilled. A slow moving bullet or a stone is retarded more by the pane and so contributes more of its energy.

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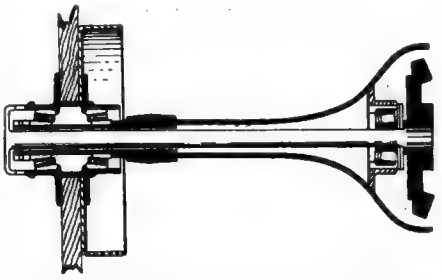
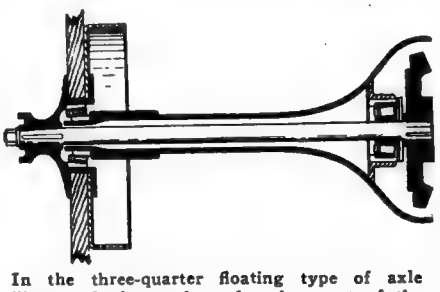
Motor Hints

By TOM C. PLUMRIDGE

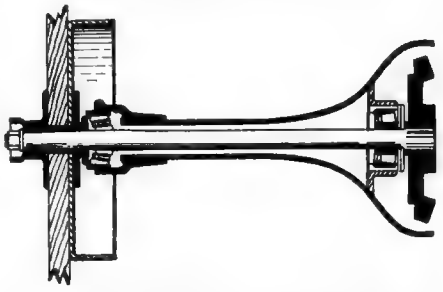
Rear Axles and Their Adjustments



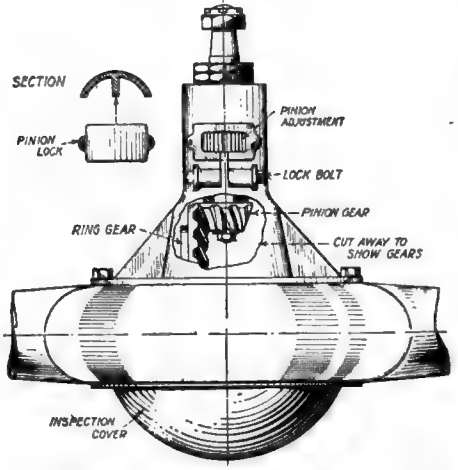
The first type of axle to be considered is known as the full floating type and is illustrated above. The entire weight of the body rests on the axle housing and the axle shafts themselves only serve to transmit the power from the drive shaft to the wheels. The axle may be removed without taking off the wheel.



In the three-quarter floating type of axle illustrated above, the axle takes part of the load of the body and also serves to drive the wheel. The axle housing takes the rest of the load that is not supported by the axle. In this type, the axle can also be removed without removing the wheel.



In the semi-floating type, illustrated above, the axle not only takes all the load but does the driving at the same time. This is a cheaper form of construction, but it necessitates taking the housing apart before the differential can be reached.



"D" Above illustration shows the location of the pinion adjustment which may be reached by removing the cover directly over the adjustment. The projection on the cap locks the adjustment in position.

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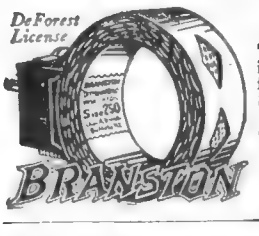

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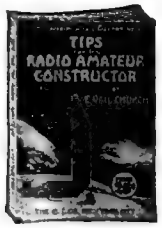

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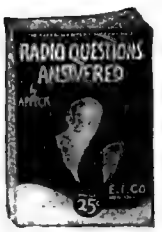

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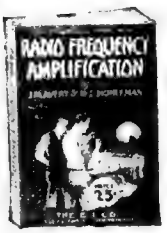

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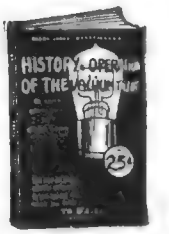

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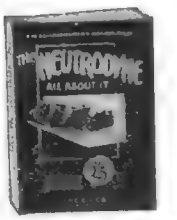

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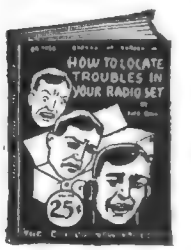

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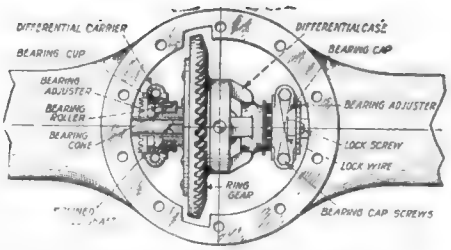
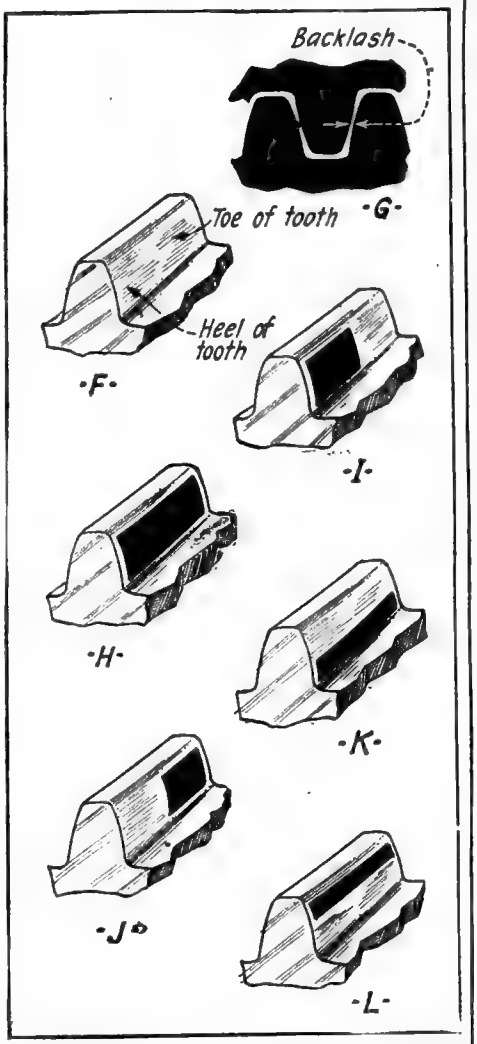


"E" The above illustration shows the remaining adjustments on a differential that are to be reached by removing the rear inspection cover.



In adjusting gears, the object is to keep the gears quiet in operation and have the greatest amount of tooth contact. F illustrates the two parts of a gear tooth known as the toe and heel. G above, shows where backlash takes place. The illustration at H shows how gears will wear if correctly meshed. If the gears mesh so that only the blackened portion of the tooth illustrated at I are wearing, the ring gear must be moved nearer to the drive pinion. To do this, loosen the bearing adjuster shown in E above, on the right side, and tighten the one on the left side. If the contact is as in J, the condition is to be corrected by loosening the left-hand adjuster shown in E and tightening the right-hand one. The condition shown in K is remedied by turning the pinion adjustment shown in D, to the left. Wear as illustrated in L is compensated for by turning the pinion adjustment to the right.

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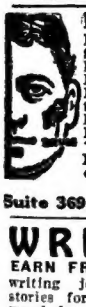

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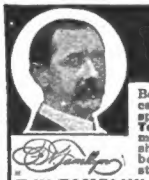

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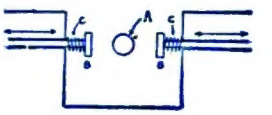

"A" is the end of a shaft. The two members "B B" are free to move in either direction indicated by the arrows. If they are pushed back, the springs "C C" will immediately pull them forward again. Our problem is to put some kind of an attachment on the revolving shaft "A" so that the members "B B" will be pushed back both at the same instant every time the shaft "A" makes a single revolution. The device on shaft "A" must also allow the two members "B B" to come forward once in every revolution. What would you suggest putting on the shaft "A"?

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Suppose, when you went home tonight, you found a window rattling. Through your mind would flash, almost instinctively, a regular order of thoughts which characterize the conception and completion of every invention the world has ever known. First, you would recognize a problem to be solved—the rattling of the window. Then you would think of several principles of science or mechanics which would solve your problem. You might think of the scientific fact that if you poured water on the frame the wood would swell and tighten the window. You might think of using a nail. But what you most probably would do, would be to use the oldest mechanical principle known to man, the wedge.

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